SILICON CHIP

OCTOBER 2006
ISSN 1030-2662
10
9 771030 266001
PRINT POST APPROVED
- PP255003/01272
$8.50* INC GST NZ$9.90 INC GST

Add CLASS to your car's dashboard!

ROTARY AND DIGITAL TACHO

- Accurate
- Responsive
- Analog and digital display

carchip

easy to fit and use 200 hr in-car data logger

REMOTE CONTROL EXTENDER

works with all infrared remotes - even FOXTEL!

Contents

SILICON CHIP

Vol.19, No.10; October 2006 www.siliconchip.com.au

Features

8 Thomas Alva Edison – Genius, Pt.2
The fascinating story of an inventive genius – by Kevin Poulter

22 Review: The CarChip E/X
This brilliant little device plugs straight into your car's On-Board Diagnostics (OBD) port and logs all sorts of data – by Julian Edgar

94 Review: Merlin Broadcast Quality Audio Mixer
A broadcast-quality unit designed for schools, colleges, training and even community radio stations

Projects To Build

26 LED Tachometer With Dual Displays, Pt.1
Jazz up your car's dashboard with this unit. It features both digital and circular bargraph readouts, all based on high-brightness LEDs – by John Clarke

36 UHF Prescaler For Frequency Counters
It divides input frequencies by 1000 and can extend the frequency range of virtually any frequency counter to over 2.8GHz – by Jim Rowe

46 Infrared Remote Control Extender
Want to control equipment via remote control from another room in the house? This new unit works with all the latest gear – by John Clarke

66 PICAXE Net Server, Pt.2
Accessing the PICAXE Net Server via the Internet – by Clive Seager

72 Easy-To-Build 12V Digital Timer Module
Looking for a low-cost 12V digital timer? Just "rat" a commercial 240V timer and add a few extra bits – by Bill deRose

102 A Reformer For Electrolytic Capacitors
Resurrect those old electros with this simple unit – by Rodney Champness

Special Columns

61 Serviceman's Log
Muggins & his bargain LCD monitors – by the TV Serviceman

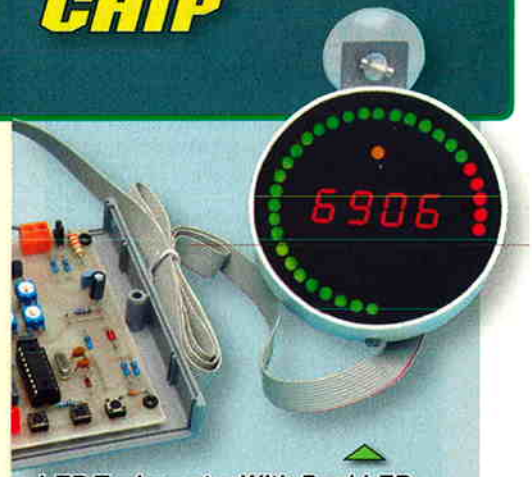
84 Circuit Notebook
(1) Battery Capacity Tester; (2) Temporarily Silencing A Smoke Detector; (3) Cheapskate's Headset Adapter; (4) Reservoir Pump Controller

89 Salvage It!
Building a super bicycle light alternator – by Julian Edgar

98 Vintage Radio
Reforming electrolytic capacitors – by Rodney Champness

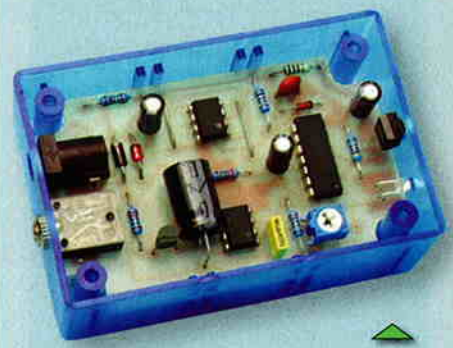
Departments

2 Publisher's Letter
4 Mailbag
35 Order Form
77 Product Showcase
104 Ask Silicon Chip
107 Notes & Errata
110 Market Centre



LED Tachometer With Dual LED Displays – Page 26.

UHF Prescaler For Frequency Counters – Page 36.



Infrared Remote Control Extender – Page 46.

12V Digital Timer – Page 72.

SILICON CHIP
www.siliconchip.com.au

Publisher & Editor-in-Chief
Leo Simpson, B.Bus., FAICD

Production Manager
Greg Swain, B.Sc.(Hons.)

Technical Editor
Peter Smith

Technical Staff
John Clarke, B.E.(Elec.)
Ross Tester
Jim Rowe, B.A., B.Sc, VK2ZLO

Reader Services
Ann Jenkinson

Advertising Enquiries
Glyn Smith
Phone (02) 9939 3295
Mobile 0431 792 293
glyn@siliconchip.com.au

Regular Contributors
Brendan Akhurst
Rodney Champness, VK3UG
Julian Edgar, Dip.T.(Sec.), B.Ed, Grad.Dip.Jnl
Kevin Poulter
Mike Sheriff, B.Sc, VK2YFK
Stan Swan

SILICON CHIP is published 12 times a year by Silicon Chip Publications Pty Ltd. ACN 003 205 490. ABN 49 003 205 490 All material copyright ©. No part of this publication may be reproduced without the written consent of the publisher.

Printing: Hannanprint, Noble Park, Victoria.

Distribution: Network Distribution Company.

Subscription rates: $83.00 per year in Australia. For overseas rates, see the subscription page in this issue.

Editorial office: Unit 1, 234 Harbord Rd, Brookvale, NSW 2100.

Postal address: PO Box 139, Collaroy Beach, NSW 2097.

Phone (02) 9939 3295.

Fax (02) 9939 2648.

E-mail: silicon@siliconchip.com.au

ISSN 1030-2662

* Recommended and maximum price only.

Publisher's Letter

Science teachers should stick to the truth

There has been considerable debate in recent months about the teaching of history in Australian schools, particularly involving the discovery and early colonisation of this country. If you are over 40, you probably learnt that the British discovered, colonised and explored the country, went through great hardships, developed the great pastoral and agricultural activities such as wheat and wool-growing and so on. But that's all changed. Now the kids are taught that the British invaded the country and basically raped, pillaged and generally displaced the aborigines. Naturally, there has been a backlash against this line and hopefully history teaching will be more balanced in the future.

But much remains to be done to change the basic attitudes of teachers to align it with what most everyday Australians believe. So much of their teaching (and the syllabus, for that matter) has a far left-wing bias which many teachers pick up when they are going through their training.

Now I have known about this left-leaning for a long time and came up against it when my three daughters were going through school. But I never had any reason to suspect that this left-leaning intruded into the teaching of science. I have now just been shocked to learn that some science teachers believe and teach their pupils that the American space trips to the Moon never happened!

In other words, they believe and promote the conspiracy theories which flourish on the internet that the space trips were all smoke and mirrors and that the TV coverage that millions of people watched in 1969 was a fake. If you read some of the cited "evidence" about the conspiracies, you have to seriously wonder why any well-educated science teacher would bother to give it a moment's credence. That any teacher could seriously pass it on to their impressionable students is simply unconscionable.

This sort of teaching is essentially based on an irrational dislike of the United States and everything it stands for. But while the USA was the winner in the space race, many other countries contributed and competed. Were they all part of the same conspiracy? And what of all the other developments in space since the Moon trips? Are they all suspect as well, to these morons?

How can you know whether this rubbish is being taught to your own son, daughter or grand-children? Unless you have regular discussions with them, you will never know. You won't know by going through their text-books or reading the subject syllabus (no-one can understand that!). This is a serious problem.

It is bad enough that the teaching of science and technology in this country is being so seriously dumbed down or just about eliminated, but when lies are being taught we have to call a halt. Clearly, the whole approach to teaching science must go back to basics. We need a complete review of the way science is taught and what is taught, just as we do for history.

Maybe we can start by polling science teachers to see if they think the American moon trips were a fake. Those that do should be fired.

Leo Simpson

RPG

Much more than an Electronics Store...

GE Finance now available!
Call us for more information!

Become a Radio Parts VIP Customer Today!

Radio Parts Group VIP CARD

Become a VIP customer and enjoy endless VIP shopping at Radio Parts Group. Shop on-line, in-store, or over the phone and receive special prices on over 6000 stocked items. Whether it's a 40" LCD TV or a 10Ω ¼ Watt resistor, Radio Parts has it all. And we will bring it to you at unheard of prices. Become a VIP Customer today and start saving by simply calling our toll free number below or sending an e-mail to info@radioparts.com.au.

AVS5800
Wireless AV Sender
- Transmit and receive AV signals through walls
- Huge range up to 400 feet clear line-of-sight
- Crystal clear video and hi-fi stereo
- Long transmission ▪ IR Extender
- Inteference free 5.8GHz
- 4 selectable channels

SAVE $50.00

5.8 GHz

IR EXTENDER

Watch your PAY TV on another TV with just one box!

RRP $249.00 OUR PRICE $199.00

DOSS

SP202
Rechargeable Spotlight
- Charges in vehicle with car cord or at home with AC adaptor (both included)
- Ideal for Auto, Boat, Camping and more...
- Built in 6V Rechargeable Battery
- Tempered Glass Lens
- H3 6 V/55 W Quartz Halogen Bulb
- 140mm Diameter Head
- Intergrated Wrist-strap
- Impact and Weather Resistant Housing

SAVE $5.00

RRP $21.00 OUR PRICE $16.00

DOSS

LED601
LED Rechargeable Work Light

NEW

NEW SHIPMENT
- Super-bright 12000MCD LED ▪ Recharge time: 1.5 hours
- Ultra-long life ▪ Swivel hanging hook ▪ Autonomy: 5-6 hours
- Water, oil, and shock resistant ▪ Switch on handle
- 110V-240V Charger and 12V Charger Included

SAVE $5.00

RRP $49.95 OUR PRICE $44.95

DOSS

PD800
Portable DVD Player
- Portable Television with built-in Tuner
- FM Transmitter ▪ Game Station
- Card Reader for your photos and music
- Driving Active Matrix 8.0" | Colour Digital TFT LCD Display
- Card Reader: Support reading SD/MS
- Analog TV Received 3 systems: PAL, NTSC, SECAM
- Rechargeable LI-ION Battery
- Image Resolution: 600 x 480 pixels
- Headphone Out ▪ Weight: 1.16kg
- Dimensions (LxWxH): 228 x 206 x 47 mm

NEW

SAVE $20.00

RRP $399.00 OUR PRICE $379.00

Wintal

SC785
Revolving Warning Light
- 12V Operation
- Simply plug-in the exendable cord to your vehicles 12V socket
- Magnetic base to attach to any metal surface

SAVE $3.00

RRP $24.95 OUR PRICE $21.95

SC217
LED Traffic Cone
- Compact, stylish and durable design
- Flashing LED for extra security
- Includes battery

SAVE $3.00

RRP $24.95 OUR PRICE $21.95

DJV-705E
Dual Screen DVD LCD Television
- DVD±R/RW, CDR/RW, VCD, DivX, MP3, WMA, JPG
- Dual 16:9 7" Widescreen TFT LCD Screens
- Built-in Electronic Anti-Shock Circuit
- IR Remote Control ▪ Carry Case
- DVD Player ▪ Analog Television
- Game Station
- In-built Game function with 2x Joysticks for multiplayer

SAVE $10.00

RRP $499.00 OUR PRICE $489.00

DX407T
Notebook Light & Fan
- Interchangeable fan & LED light heads
- Retractable built-in cable
- Swivel directional head

USB ENABLED

SAVE $5.00

RRP $24.95 OUR PRICE $19.95

DOSS

DX656
WIFI'n'Spy Finder
- A smart, dual-function detector for wireless hot spots and hidden cameras!
- Locate a hot spot (802.11b/g wireless internet access point) without opening your notebook computer!
- Detect any wireless hidden camera that might be invading your privacy!

SAVE $5.00

RRP $39.95 OUR PRICE $34.95

DOSS

RX1000
2 Channel Stereo Receiver

Wintal

- Digital AM/FM tuner with 64 station presets, (AM 32 Preset, FM 32 Preset)
- Auto Memory Preset (AM/FM separate)
- Tone Control (treble/bass)
- 4 stereo audio inputs; 1 stereo audio outputs
- Fully functional remote control
- Stereo mode: 100Watt+100Watt 8Ω RMS
- Signal to noise ratio>85 dB
- Dimensions: 435mm(L)x363mm(W)x144mm(H)
- Tuner: 75ΩFM/AM LOOP
- Audio In: 1 x Amp In, 4 x Left/Right RCA Inputs

SAVE $50.00

RRP $299.00 OUR PRICE $249.00

3 YEAR WARRANTY

IR500
Wireless Headphones

Wintal

- interference free sound quality
- Operating distance up to 23 ft
- Personal volume control
- Easy to operate
- Infrared Transmitter
- Infrared Headset
- AC/DC Adaptor
- Mono male 3.5 & 6.3mm jacks

SAVE $10.00

RRP $49.00 OUR PRICE $39.00

WH24USB
Wireless USB Headphones
- Operating distance of up to 30m with perfect reception!
- Power On/Off, Power On indicator and Volume control located on headset
- 92dB Audio Dynamic Range
- 8 selectable channels
- Low Power Consumption
- 2.4GHz ISM Band with
- FSK Digital Modulation / Demodulation

2.4 GHz

SAVE $30.00

RRP $119.00 OUR PRICE $89.00

Wintal

RADIO PARTS GROUP

BRISBANE WHOLESALE ENQUIRES!
For sales contact Danny Swann
Mobile: 0409 582 027
E-Mail: dannys@radioparts.com.au
Tel: (07) 3392 8333 | Fax: (07) 3392 8777

e-mail.
info@radioparts.com.au

web.
www.radioparts.com.au

Free call:
1800 337 366

***SALE ENDS 30/10/06**

Head Office
562 Spencer Street, West Melbourne, VIC
T: (03) 9321 8300 | F: (03) 9321 8333
MON - FRI 08:00 - 17:15 SAT 09:00 - 16:00

Branch
1097 Dandenong Road, East Malvern, VIC
T: (03) 9571 8122 | F: (03) 9571 8244
MON - THU 09:00 - 18:00 FRI 09:00 - 21:00
SAT 09:00 - 17:00 SUN 10:00 - 17:00

MAILBAG

Dubbing 78s to CD

Your article on the Magnetic Cartridge Preamplifier in the August 2006 issue is interesting, as I have experimented in transferring audio from records to CD. I have a good quality turntable but it has only 33 and 45 RPM speeds. For 78 RPM records, I have played the records at 33 RPM with a 78 RPM pickup cartridge, and used the editing software to subsequently correct the pitch. I built a preamplifier based on the Universal Stereo Preamplifier (SILICON CHIP, April 1994) which uses the same compensation circuit as your new preamp for the RIAA LP specifications.

I included switched alternative compensation for a couple of 78 RPM equalisation curves. The time constants were also adjusted for the pitch ratio of 77 to 33 RPM. I had assumed that the editing software would modify only the pitch. The system worked but the results were not as positive as expected. Perhaps my calculations of the time constants were at fault.

I would be interested if you could investigate the question of the equalisation where there is a pitch change and perhaps offer a design review of your preamplifier to allow for others who are unable to play 78 records at correct speed.

Ross Kirkham,
via email.

Comment: changing the playback speed from 78 to 33 RPM really is not the best way to go about it. Not only will the pitch change but the equalisation time constants all have to be shifted down in frequency to compensate (this aspect is covered briefly in the next article, in September). However, because all the signal frequencies are shifted down by more than 2:1, the output of the cartridge will be reduced substantially and the signal-to-noise ratio (ie, signal-to-surface noise) is likely to be degraded as a result.

More breakout boxes needed

I think SILICON CHIP articles need some basic explanations boxes. For example, the August 2006 article about the Ultrasonic Eavesdropper was discussed in the context of a radio receiver without ever actually explaining how the radio receiver worked – it was assumed knowledge.

The same thing happened in the September 2006 issue on LP records. If anyone under the age of 35 has the faintest idea of how LP records work I'd be amazed! For example, why, specifically, are levels higher for higher frequencies with a magnetic cartridge? I assume that this is like an AC generator where amplitude increases with frequency of rotation but that is just my assumption.

These articles and many others would work so much better for a wider variety of people if some basic explanations were included. There's very much an air of "of course you all know how this works" which I think must exclude the content from many.

The same applies for nearly every constructional project that uses standardised circuit ideas (Schmitt triggers, etc). If the explanations are in breakout boxes, the experts don't need to read them. Lots and lots of back-to-basics breakouts would be hugely advantageous, with zero detraction for those who already know it all.

Julian Edgar,
via email.

Comment: you are right. Most articles on electronics do assume a certain level of background knowledge. The same assumption occurs in any specialist publication, no matter what the subject.

To be fair though, the basic heterodyne principle used in the Ultrasonic Eavesdropper was clearly described and supported by a diagram (Fig.1 on page 73).

Magnetic cartridges are velocity-sensitive devices. A typical moving magnet cartridge has an output of 1mV/cm/sec which relates to the velocity of the groove modulation.

Compressed natural gas is the right way to go

Let me say how strongly I agree with the September 2006 Publisher's Letter regarding CNG for our vehicles. It is a perfect fit for Australia.

Your readers might like to know that if there are any doubts on the availability of the technology, all they have to do is visit New Delhi. All commercial passenger vehicles there (three-wheelers up to buses) now run on CNG by law. The impetus was pollution control – particulate pollution in the city dropped 80%, by the way. The technology exists.

Unfortunately, there are two vested interests that will try to stall such progress here: oil companies and our government. When the same idea was suggested in Texas in the 1990s (oil was $18/barrel then!) it was slowly crushed by the oil companies.

Imagine this very plausible scenario if you already have natural gas piped to your home for cooking/heating: A compressor is installed in your garage. Every night, you drive in, connect the compressor, and go inside. Next morning your car has a full tank of CNG. Big oil will not like this as they are excluded from the retail sales. Big government will not like this, as they would loose huge fuel excise taxes. Government will either have to slap on an excise on "home" gas or make us have two meters for each house so they can charge different prices for the (same) gas going into the car and the gas heating the kettle.

Rob Clark,
via email.

50th birthday of TV in Australia

The 50th anniversary of the introduction of TV to Australia brings back

DVD regions: a farce?

As an inveterate internet shopper I have long been frustrated by the excellent DVDs available overseas which are not available here and which cost much less than the local product. And I found the division of the world into DVD "regions" both frustrating and silly. I know it's supposed to prevent piracy but it always seemed like overkill.

A friend who is involved in the business suggested to me that if I wanted to buy DVDs designated for regions other than our Region 4, I should go right ahead and that I would find they would play on most Australian-marketed DVD players. In particular, he said, they would play on the cheaper DVD players available from chain stores, which he said, did not contain the circuitry needed to discern between regions. It turns out he is right.

I bought a couple of Region 1 (USA) DVDs on the internet and also bought a DSE G1928 ($50) player and a Base DV 350 (from Target: $58). Both were embossed with a "4" on the machine and both played the Region 1 DVDs and, later, DVDs from other regions, without any trouble. Then, leafing through the manual of my much more expensive Philips MX 5500D player and surround sound system, I noticed a loose page, containing a code, which, entered into the player, it said, would allow it to "play DVDs from other regions." It's been cheerfully playing DVDs from all regions, ever since.

I have also tried five other DVD players belonging to friends and family and only one very early model has refused to play "foreign" DVDs. So what was all the fuss about? Who's kidding whom? And why go stamping "4" on players that readily play all regions?

Have the DVD manufacturers seen the folly of this arbitrary carve-up of the world or did the player manufacturers quietly give up on them?

John Tingle,
Port Macquarie, NSW.

many memories. In 1956, I was 10 years old. People had their eyes glued to television sets displayed in shop windows and had earnest discussions on how close to the TV to sit, the best lighting arrangements for the TV room, and the best sort of antenna.

I was delighted that SILICON CHIP has issued a DVD of all the issues of "Radio and Hobbies". In 1957, it published articles which raised the exciting possibility of making your own TV. My father was a radio ham and an electronics enthusiast and because of him I had developed a fascination for electronics.

It took about a year but in due course I built my own 5-inch TV, using a 5BP1 tube (and later a 6-inch VCR97). Sockets for the VCR97 were very rare and I soldered the wires directly onto the pins (actually flat sliding contacts, if I remember correctly). As a 12-year old I was of course rather proud of myself but the most irritating questions were "Did you make all the resistors and condensers yourself?" and "Why is the picture green?"

Just for fun, I also connected up a 1-inch cathode ray tube (1CP1) and got a picture the size of a postage stamp. A couple of years later I dismantled the 5-inch set and built a 17-inch version which the family used for many years. It was not that unusual for people to build their own TV in those years and several of my friends did likewise.

Later on, the ham radio bug hit. In 1961, I listened to the first satellite carrying an amateur radio transmitter on the two metre band. It was called OSCAR (Orbital Satellite Carrying Amateur Radio). My father calculated its distance and velocity from the Doppler shift as it passed overhead with its Morse message "HI".

Inspired and taught by him, I sat and passed the Theory and Regulations exams for the ham radio license at the age of 15 but you had to be 16 to get the licence. Imagine my surprise and delight when I woke up on July 21, 1962 to find my licence among my birthday presents! My father had been able to persuade the authorities to issue my licence on the strict understanding

Atmel's AVR, from JED in Australia

JED has designed a range of single board computers and modules as a way of using the AVR without SMT board design

The **AVR570** module (above) is a way of using an ATmega128 CPU on a user base board without having to lay out the intricate, surface-mounted surrounds of the CPU, and then having to manufacture your board on an SMT robot line. Instead you simply layout a square for four 0.1" spaced socket strips and plug in our pre-tested module. The module has the crystal, resetter, AVR-ISP programming header (and an optional JTAG ICE pad), as well as programming signal switching. For a little extra, we load a DS1305 RTC, crystal and Li battery underneath, which uses SPI and port G.

See JED's www site for a datasheet.

AVR573 Single Board Computer

This board uses the AVR570 module and adds 20 An./Dig. inputs, 12 FET outputs, LCD/Kbd, 2xRS232, 1xRS485, 1-Wire, power reg. etc. **See www.jedmicro.com.au/avr.htm**

$330 PC-PROM Programmer

This programmer plugs into a PC printer port and reads, writes and edits any 28 or 32-pin PROM. Comes with plug-pack, cable and software.

Also available is a multi-PROM UV eraser with timer, and a 32/32 PLCC converter.

JED Microprocessors Pty Ltd
173 Boronia Rd, Boronia, Victoria, 3155
Ph. 03 9762 3588, Fax 03 9762 5499
www.jedmicro.com.au

that he would not give it to me until I turned 16. I doubt that this would be allowed nowadays.

The Moon landing was on July 21, 1969, my 23rd birthday. I was a medical student and we were in the middle of a Pathology class. The laboratory at Monash Medical School had closed circuit TV monitors connected to the demonstrator's microscope but on that day we interrupted the practical session to watch Neil Armstrong set foot on the Moon in real time, and utter his immortal words. The Americans celebrate the occasion on July 20 but Australia is (was) a day ahead.

Television in Australia is 50 years old. I celebrated my 60th birthday this year with an article in "The Australian" (written with my friend Bruce Leyland) on the decryption of the Dedication to Shakespeare's Sonnets, confirming Brenda James' assertion that it contains hidden messages that reveal the true author to be Sir Henry Neville. Decryption did not involve any electronics but my personal computer was a great help in typesetting the graphics.

I have to admit that the world is not yet convinced. But to quote Eliza Doolittle from the 1950s hit musical *My Fair Lady*, "Just you wait, Henry Higgins, just you wait".

Professor Jim Goding, VK3DM,
Department of Physiology,
Monash University, Clayton, Vic.

Comment: many of us contemporaries can remember the moon-walk in 1969. The editor was in the laboratory at "Electronics Australia" at the time and we all stopped work to watch the momentous event on a 21-inch TV set designed and constructed by Jim Rowe.

It is strange that there are now conspiracy theories propounded on the internet that the USA never went to the Moon! Such is the irrational hatred for the USA in some quarters. Weird!

Comment on TV history

I congratulate Kevin Poulter on his interesting series on the history of TV in Australia. This history would not be complete however, without some understanding of how TV programs were relayed around Australia.

From the early 1960s onwards, the Post-Master General's (PMG) Department constructed a vast network of broadband (analog) microwave links between major population centres around the country. By the mid 1960s all major cities, with the exception of those in the NT and possibly WA, were connected via this network. This was the means by which all of the TV networks, commercial and ABC, relayed their programs around the country. Satellite relays within Australia only appeared as an alternative during the late 1980s.

Each radio "bearer" could typically carry either one TV program or 1200 telephone channels and required a repeater every 30-40km. There were typically 12 such bearers between capital cities. The PMG also built a co-axial cable network but this was rarely used for television.

Contrary to the author's comments, the ABC regional TV service was relayed live from ABC studios in each state capital to regional transmitters via the PMG's microwave network. Almost all program content was relayed live with very little originating from regional studios. It was this network which made the ABC regional TV service possible.

It is interesting to note that in those days the Government was willing to provide important telecommunications infrastructure when it was needed regardless of the cost, whereas today it seems, corporations only consider the "bottom line" when deciding to upgrade the backbone telecom network. The public interest, it appears, is not their first priority.

Malcolm Walker,
via email.

Plugpacks are undesirable

I have noticed that the majority of smaller SILICON CHIP projects which are powered from 240VAC mains, invariably rely on the ubiquitous "plugpack".

I can well understand why a plugpack AC or DC supply might be preferred for a particular design but there are many projects where this solution may not be the most appropriate. For small low-powered projects which will fit in small plastic or metal "jiffy" boxes, an internal transformer may unjustifiably increase the physical size and weight but many projects would be better off by using one.

Plugpacks introduce two points of unreliability, one due to the weight of the plugpack itself and the other due to the poor design of the coaxial plug and socket arrangement at the appliance end. They are usually fitted with quite flimsy figure-8 flex which can be easily damaged due to rough handling and in some cases the plug and/or socket, or even the PC board on which the jack is mounted, can be damaged.

Plugpacks also tend to place a fairly heavy physical strain on GPOs and it is not uncommon for them to fall out of the GPO due to their bulk, or get knocked out unintentionally. I know of cases where items of business communications equipment have failed due to office staff accidentally knocking a plugpack so that it stops operations. A maintenance engineer gets a service call to come and fix the system and that makes for an expensive and embarrassing fix.

Some business offices I have visited try all sorts of tricks to overcome the problem such as tying the plugpacks down to multi-outlet power boards using adhesive tape or Nylon cable ties. Where several plugpacks are required to power different pieces of co-located equipment, it is often impossible to fit them side-by-side in adjacent GPOs due to their bulk.

These items are generally inexpensive, particularly the simple AC type, but the regulated and switchmode types get progressively more expensive depending on output capability and voltage. However, I think that SILICON CHIP, in the interests of both good engineering practice and reliabil-

ity, should raise its sights and incorporate internal power transformers in their projects where possible.

Back in the days prior to the appearance of plugpacks, electronics magazines such as EA, AEM and ETI (among others) had no option but to use an internal transformer and there were no real disadvantages or hazards encountered. Except in rare situations, I don't think things have changed much in that regard.

There are many small transformers, both chassis-mount and PC-mount, which are readily available from Altronics, DSE, Jaycar, RS Components and Farnell. Although 3VA is the smallest size available at Altronics, it is not difficult to obtain 1.15VA types from RS and Farnell with which you can build a linear regulated DC supply measuring 70 x 40 x 30mm complete with a screw terminal input connector.

One particular SILICON CHIP project which I was interested in building was the 4-Channel A/V Selector, published in April 2006. Here we have an enclosure with acres of board space inside going to waste and the thing is being powered from a damned plugpack. Surely it would be more practical and would promote good engineering design practice to utilise a fully integrated internal power supply. There are a number of other SILICON CHIP projects which could also be provided as examples.

I anticipate that one of the reasons offered as justification for their use will be that of electrical safety, particularly where inexperienced constructors are involved. To that I would answer that when we were learning the trade as kids we had to be aware of the hazards involved with 240VAC. An occasional "nip" from a project we were working on didn't kill us then and it served to make us even more careful. Of course, in today's litigious society, magazines such as SILICON CHIP have to be more careful.

Ross Herbert,
Carine, WA.

Comment: we agree with all your objections to plugpacks. Many of them are cheap and nasty, have high magnetising current and excessive magnetic leakage and are a loose fit in the 3-pin sockets. You have also put your finger on the main reasons we use them: cheap, convenient and no mains wiring in the project – a big factor in their acceptability for school projects.

More equalisation networks needed for preamp

I refer to the Magnetic Cartridge preamplifier in the August 2006 issue and to the article on dubbing LPs to CDs in the September 2006 issue.

Firstly, both articles are excellent for their respective purposes. A lot of research has gone into the preamp's EQ designs for the numerous recording standards used in earlier days. In the second article, quite an amount of the text is devoted to the issue of EQ selection for various records.

The principle thread, as embodied in the text, is the need to be able to select the right EQ for each and every record one wishes to play and record. Unfortunately, there are more EQ curves than selectable links – there are five microgroove, five coarse groove, three flat and one tape.

The problem for all users of the preamp is the practical difficulty in being able to meet such ongoing needs; ie, the difficulty in easily changing between any of these EQ response curves, apart from the three hard-wired EQs – and even those need the cover to be removed on each occasion.

Could the circuit be revised to incorporate all 11 EQ positions? This could be switched by a rotary switch, pushbuttons, relay, etc at a moment's notice. The gain in functionality and utility would be immense.

For those who wish to simply continue to play the original recordings (ie, without a desire to record them digitally for future use), such a box would be a normal part of their playback chain and so could be given prominence and not placed "out of the way". Perhaps this could be a 1U rack box? This would have room for LED/pushbutton pairs for selection of all equalisation.

Graeme Dennes,
via email.

Comment: it certainly would be possible to have a preamp with switched feedback networks for all possible equalisations but it would be quite messy in the wiring. We don't think it would be worth the trouble to design a special PC board to do this.

It would probably be better to have the extra networks on a piece of Veroboard with all the wires brought up to a 2-pole 11-position switch – if you can get such a device. Also, the switch should have make-before-break contacts otherwise there will be enormous thumps from the preamp if you switch equalisation while it is powered up. **SC**

"MERLIN" Practical and Versatile Mini Broadcast Audio Mixer

Safe External Switchmode Power Supply

Broadcast Quality with Operational Features and Technical Performance identical to full sized Radio Station Mixing Panels

Permanent Installation is not required, the "Merlin" is as easy as a Stereo System to "Set Up",all connections via Plugs and Sockets

The "Merlin" originally designed for Media Training use in High Schools and Colleges is a remarkably versatile Audio Mixer

Applications: *Media Training - Basic Audio Production - News Room Mixer - Outside Broadcasts - Radio Program Pre Recording - On-Air Mixer in small Radio Stations - "Disco Mixer"*

The "Merlin" is an Affordable Professional Audio Product

Buy one for your School, College, Community Radio Station, Ethnic Radio Broadcast Association or for yourself

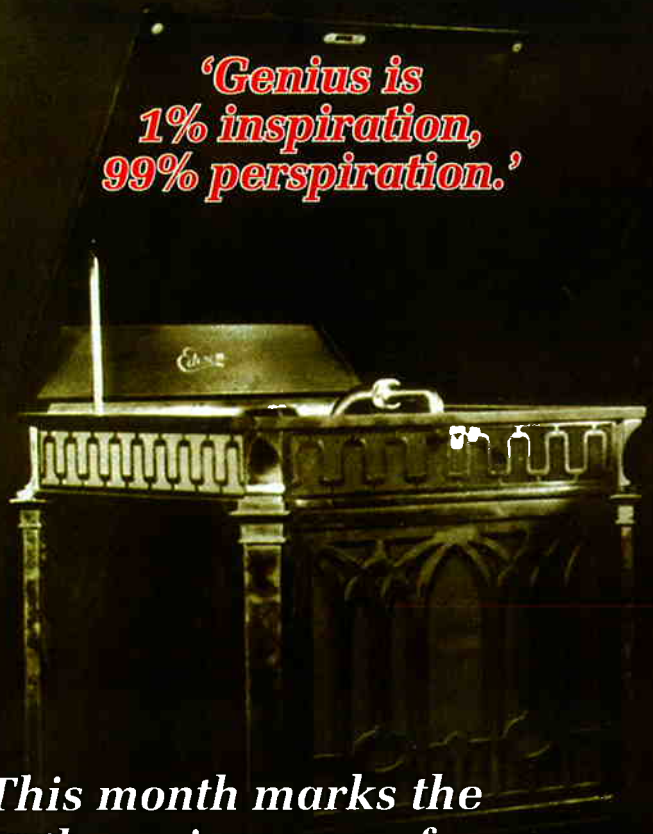
For Details and Price, please contact us at

ELAN AUDIO
2 Steel Court. South Guildford
Western Australia 6055

Phone 08 9277 3500
Fax 08 9478 2266
email sales@elan.com.au
www.elan.com.au

Part 2 –
by Kevin Poulter.

'Genius is 1% inspiration, 99% perspiration.'



This month marks the 75th anniversary of Edison's death. While his genius was recognised during his lifetime, it's only since his passing that the magnitude of that genius started to become appreciated.

Edison wins the patent wars

Thomas Edison discovered three amazing keys to business success: hire people with different skills than you possess, employ others to multiply your expertise. . . and the company who has the patents wins.

He organised hundreds of inventors and craftsmen working in buildings, soon called 'invention factories'.

Edison was titled by journalists 'the wizard of Menlo Park', as creations such as the phonograph were so startling, some thought only black magic could produce such amazing technology. This is difficult to imagine today, as we are surrounded by masses of sound devices but in an era when the only sounds came from nature, recorded sound was beyond belief.

In its early years, the phonograph was so startling and mystifying, it was even demonstrated personally to the US President and presented by spruikers in side-show alley tents, alongside other amazing sights, fakes and illusions.

Edison hated the time-consuming and expensive process of engaging patent attorneys, preparing the patent documents and applying but he knew exclusive patents guaranteed business. By patenting part of a process or design, Edison held the trump card, even if he was not the original inventor of the device.

For example, some of his patents supported and described a particular detail, like the shape of the light-globe envelope, or the method of making the envelope. One patent even covered the style and design of a wooden phonograph cabinet, right down to the ornate scrolled cut-outs.

Edison applied for his patents in many countries, even the Australian states of Victoria and Tasmania! A recent search (for this article) resulted in records of Edison patents granted in Australia from 1878 to 1903.

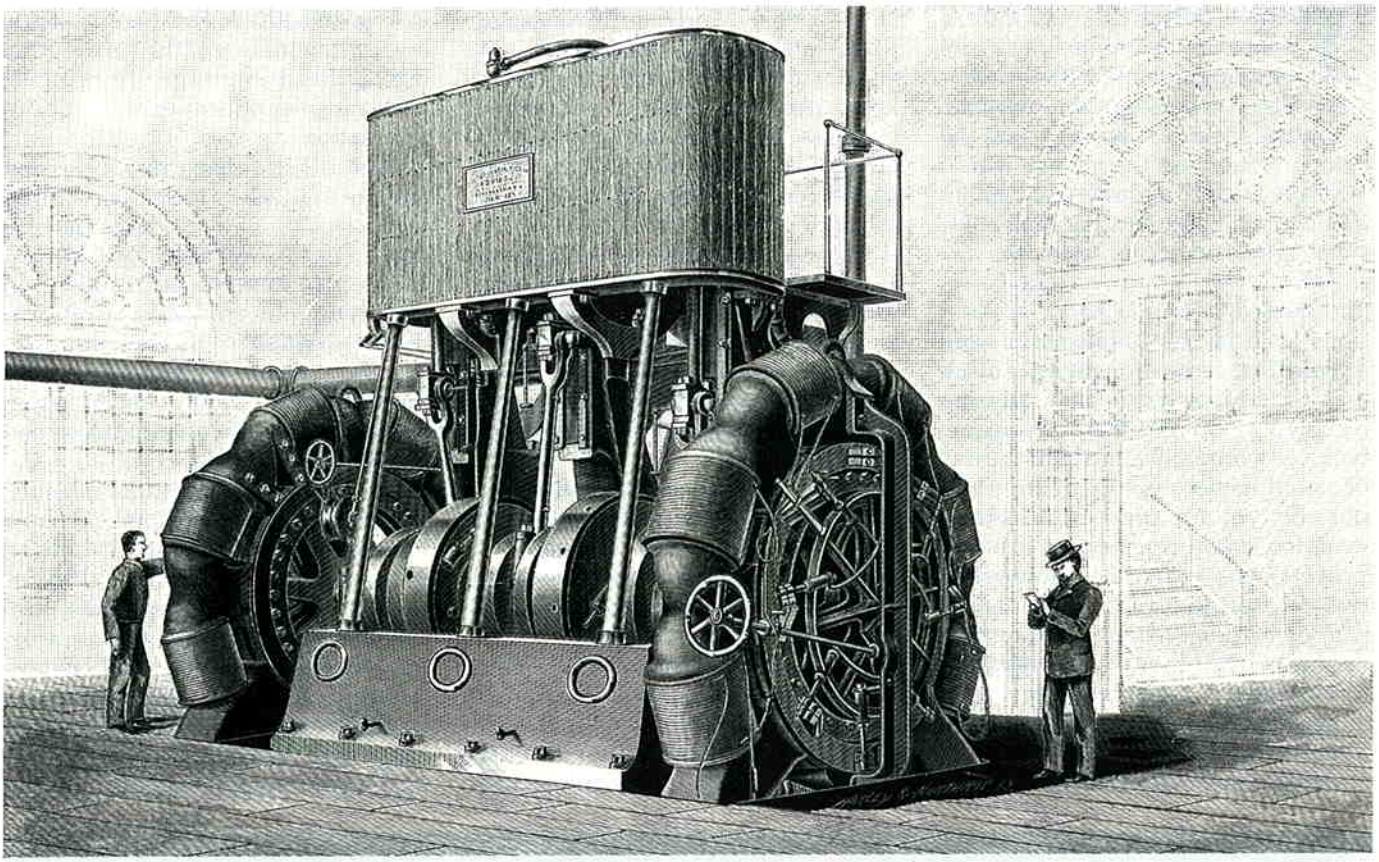
Edison established 1093 US patents, more than issued to any other, through the 'Edison Department' in the US Patent office. His genius reached worldwide, with successful patents in over 20 nations. Few people of this era have an inkling of the vastness his billion-dollar empire grew into, or the wide range of Edison inventions and production.

Most of all, Edison had a passion and fire to invent. One of his workers said years later, "Mr Edison had his desk in one corner and after completing an invention, he would jump up and down, doing a kind of Zulu war dance. He would swear something awful. We would crowd around him and he would show us the new invention and explain it to the pattern-maker and tell us what to do about it."

His inventions (or improvements) include the electric lamp, concrete houses, the phonograph, methods of processing ore, weapons, 'alkaline' batteries, document duplicators, electric pen, magnetic 'iron finder', electric generation stations, multi-channel telegraph signals over one wire, plus an electric train. Edison also made other's inventions a practical reality – like making the telephone loud enough to

EDISON'S GREATEST MARVEL
THE VITASCOPE
"Wonderful is The Vitascope. Pictures life size and full of color. Makes a thrilling show."
NEWYORK HERALD, April 24, '96.

Edison purchased rights to the Phantoscope, producing the projector as a new Edison invention named the Vitascope. Exhibitors could choose films from the Edison Studio inventory.



The 1892 Edison Multipolar Dynamo, driven by a Triple-Expansion Engine and designed for large electrical power requirements, like town grids. One of Edison's few mistakes was to apply all his inventive powers into DC for town and rail supplies. Until recently, DC remained as the preferred supply for railways, with the inevitable voltage losses along the line.

be heard over long distances.

Electricity generation

To grow his business, especially supplying town electricity equipment, Edison spent a fortune taking huge dynamos and equipment to major shows in America, Europe and the United Kingdom. Equipment was sold in the area, where possible, to save the expense of a return journey.

His phonograph was sorely needing development, forgotten for years after the initial launch, as Edison was distracted by new inventions, especially those related to developing electricity supply systems.

When Edison decided to take the bold and expensive step of participating in the 1881 International Exposition of Electricity in Paris, an associate suggested an improved phonograph would create interest. So the amazing sound reproducer was finally revived and improved.

At the Paris Exhibition, Edison displayed his super-dynamo, though many people and press thronged en-masse to his phonograph demonstration, listening in amazement!

Prominent buildings around the world and the Exhibition were illuminated with lamps from a number of inventors. The dynamo was later moved to London, where it lit 3,000 street-lamps, a church and the main post office.

Not all of Edison's inventions made money; in fact some lost a fortune. He was convinced a concrete house made from standard mouldings would offer the masses a strong, economical, comfortable home. He was right but hurdles like the availability of alternatives such as cheap and plentiful timber killed the project and Edison lost money. More than a century later, concrete panels are the material of choice for most factories, skyscrapers and even homes – in the form of apartments.

His biggest mistake was an unwavering support for DC, with its inherent losses along long lines. Edison declared that AC was unsafe and had public arguments with people like Westinghouse. He even tried to get AC over 800 volts banned.

Edison's staff included carpenters, glass-blowers and metal engineers, as inventions had to be made into working examples, to test, display and prove the idea was practical. Well-crafted working prototypes were presented to financiers, for funding the production in large numbers.

He also employed the best scientific minds of the era, such as Tesla, who championed the concept of AC. Tesla left, complaining Edison had cheated him out of a $50,000 bonus for improving the dynamo. Tesla next sold an improved AC electric motor design to George Westinghouse. In 1912, when Edison and Tesla both were nominated to receive the joint Nobel Prize, Tesla declined and neither ever received this honour.

Other brilliant inventors liked the secure jobs of the 'Invention Factory', as few had the production and promotional acumen of Edison.

Despite being the administrator, Edison worked around the clock, his hands marked with cuts, cracked and stained like any of his production workers.

His clothes were not the elegant suits of a leading businessman either, rather the well-worn appearance of a manufacturing worker. Visitors some-

A re-enactment of Edison and his staff producing the first glass envelopes for lamps – from the 1940 Metro-Goldwyn-Meyer film, 'Edison the Man'. Spencer Tracy (right) portrays Edison, with a genuine glassblower (centre), employed by the Studio. This globe is a replica of the one that is believed to have been used by Edison to achieve a perfect vacuum.

times would mistake Edison for one of the workmen.

Edison established financial and production partners across the world, creating new companies to manufacture and market his products. Some developed from legal conflict, like the patent battle with the British inventor, Sir Joseph Swan, a chemist and electrical engineer.

The lamp

The concept of the electric lamp was known for many years but the elusive component was the filament. No metal known to the science of the time could be heated to incandescence, without burning away. Also it was becoming clear that any filament needed to be in a complete vacuum to remain intact.

Edison experimented with 1600 earths, minerals, plants and threads in the quest for a reliable filament. A broken fan in his workshop was cannibalised for a strip of bamboo, giving such promising results, Edison declared 'Somewhere in God Almighty's workshop, is a dense, woody growth with fibres almost geometrically parallel and with practically no pith from which we can make the filaments the world needs'.

In his quest for this extraordinary plant, Edison despatched people to the ends of the earth; to far-flung lands such as the Orient, China, Japan, Brazil, Cuba, Peru, Ecuador and Columbia.

As a result, Edison obtained 6000 distinct plants, most of them bamboos.

During his experiments, he discovered the 'Edison Effect', where electrons not only flowed through a vacuum but only in one direction. He coated the outside of a lamp with tin foil and noted a current flow between the hot positive terminal of the filament and the tin foil.

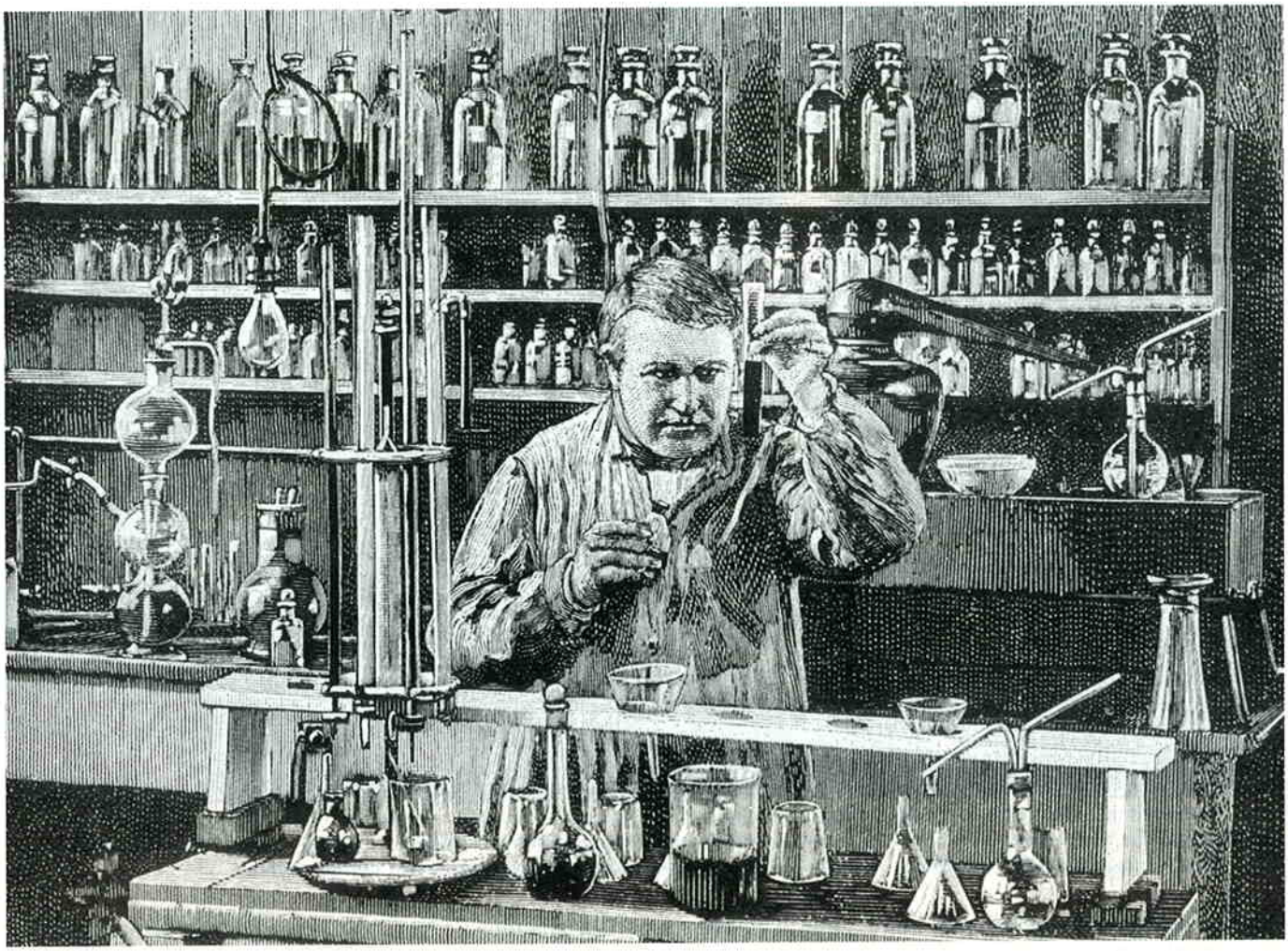
Edison incorporated the phenomenon in a patent as a voltage regulating device but nearly 25 years later, Fleming found the first use of this 'diode effect'. Soon Lee De Forest employed the same techniques in his radio inventions.

Enter Joseph Swan

In 1845, Swan was sure a carbon filament lamp would work and from 1848, he too experimented with numerous materials to produce the carbonised filament. By 1855, he made a bright glow from a short strip, powered by fifty battery cells. Like Edison, Swan was almost simultaneously finding the lack of a perfect vacuum was the remaining problem. And like Edison, he found technology that produced a near-perfect vacuum and then a longer-lasting filament, producing working lamps in 1878.

To his regret, for nearly two years and despite prompting from his assistant, Swan didn't patent the concept. Swan said so many people already had worked on the electric lamp, it was not capable of sustaining a patent. How wrong he was! Edison saw the international potential and patented the carbon filament lamp in the UK on November 10, 1879.

Edison now had the UK patent, contesting Swan's right to manufacture electric lamps. Edison won the patent war but Swan then patented the method of creating a perfect vacuum, by making the filament glow while evacuating the globe, plus another breakthrough – parchmentised cel-



Edison in his lab. First and foremost, Edison was a chemist.

lulose thread filaments – soon to become the standard for all commercial lamps.

This impasse was solved by Edison commercially joining forces with Swan in the UK in 1881, forming a virtual monopoly, the Edison and Swan United Electric Light Company Limited. Their lamps were later marketed under the 'Ediswan' brand.

Patent wars with other electric lamp pretenders continued, fuelled by competitors, who decided if Swan could be shown as the inventor of the filament lamp in the UK, then Edison's patent would be bad, based on 'prior user'.

In an astounding move, to protect the now successful Edison/Swan commercial enterprise from all outsiders, Swan's factory mustered great resources to show the carbon conductor was not a filament.

They won the case but this further obscured Swan's honour as the inventor of the first practical lamp.

Sir Joseph Swan is also recorded in history as the inventor of a carbon printing process and patented photographic paper coated with bromide emulsion in 1879, plus other products such as artificial silk.

Edison's lamps first illuminated theatres in London, Berlin and Prague, breweries, paper and woolen mills in France and Germany and factories in Europe.

He even illuminated Australia, providing lighting for the government buildings in Brisbane and The House of Assembly in Melbourne.

In the book 'Historic Houses Trust of New South Wales, 1984' Shar Jones Glebe states '*Electricity was established in Sydney in 1879. Three years later an entrepreneur, Henry Kingsbury, purchased exclusive rights to sell Edison bulbs. Kingsbury was later sued for infringement of patent rights and as a result, Edison's rights were upheld in New South Wales. The first suburbs of Sydney to be connected with electricity were Redfern and Woolloomooloo.*'

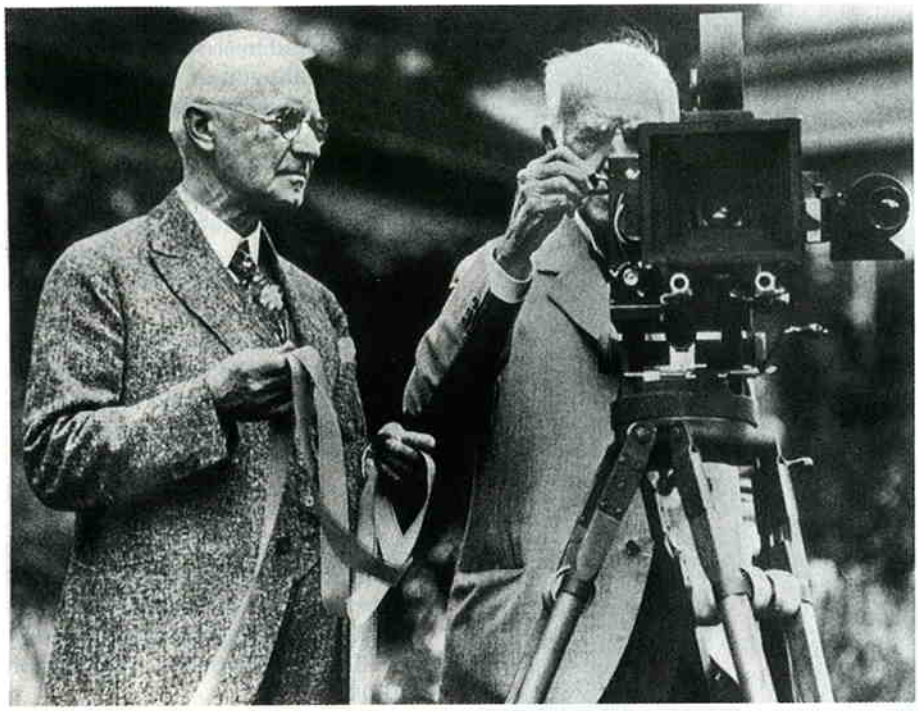
In a development that foreshadowed the glare of Las Vegas, an illuminated 'Edison' sign was featured at London's Crystal Palace Electrical Exposition in 1882, followed by a motor-driven sign at Berlin's Health Exhibition the following year. The sign spelt out Edison's name, letter by letter.

He was also a good promoter, employing a man to walk around exhibitions, handing out leaflets, with lamps wired to his clothes from the hat down. When the spruiker reached discreet contacts in the floor and stood on them, he would light up. Similar displays illuminated promoters in busy streets.

Edison's lighting systems reached across the globe, including a lighting and electrical fire-alarm system, installed in four hotels.

Back in New York, the benefits for industry and commerce were rapidly revealed. One wholesale grocery company had 50 clerks working under gas-light, at risk of their health. The huge room of staff soon enjoyed pollution-free electric light.

siliconchip.com.au



Thomas Edison worked closely with George Eastman of Kodak, using Eastman's film in early motion pictures filmed by Edison's crews. Many of Edison's first movies remain and can be seen on-line. The 35mm film shown here is the same dimensions as the miniature film used in domestic cameras by the late 1930s, through to today.

Telephone transmitter

Many inventors experimented with the telephone or 'speaking telegraph', as it was then called.

One year after Alexander Graham Bell patented the telephone in 1876, Edison designed a superior transmitter, the carbon microphone, one of the most important inventions ever, installed in billions of telephones until recent times.

He also determined how to increase the electrical signals, boosting the telephone's range from a few kilometres to hundreds of kilometres.

Western Union bought the improved telephone patents for $100,000, which Edison asked to be paid in seventeen yearly instalments – not trusting himself with all the money. He had made and lost fortunes before. Western Union promoted the telephone as a super-telegraph, connected and spoken by an operator. Home use was not considered, as homes didn't have electricity.

Comparing Bell's and Edison's telephone was no contest. Edison's was much louder. Despite battles over the telephone patents, Edison and Bell became friends and business partners.

Working with Edison was reportedly friendly, with Edison rapidly developing new ideas. He said "very often I will work at a thing and get where I can't see anything more of it and just put it aside and go at something else... the first thing I know, the very idea I wanted will come to me. Then I drop the other and go back and work it out."

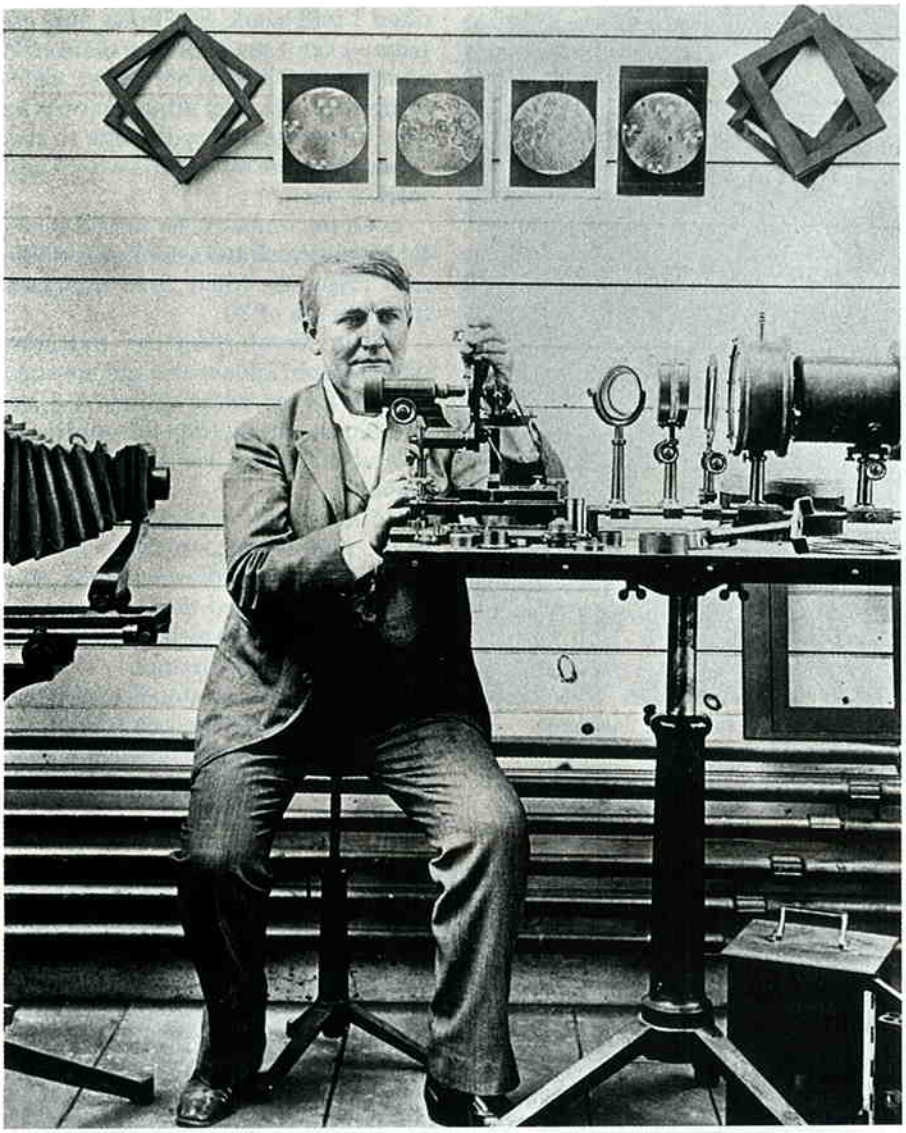
Even in company, he would reach for his notebook and sketch or scribble new ideas. He filled 3000 notepads from the age of 30.

While developing the cylinder phonograph, Edison also precursored designs for recording sound on disks and tapes, predicting the audio-reproducer's main use as a dictating machine.

He also made miniature versions of the phonograph, installed in talking dolls and children's pianos. The talking doll housed the tiny cylinder phonographs, with girls in the factory recording nursery rhymes.

His companies produced media too, like cylinders with recorded speeches, sounds of nature and music (later on 78 rpm discs) and motion picture films.

Edison produced 'Alkaline' batteries for use in electric vehicles, as seen in this 1911 photograph.



Edison with optical components in 1913. Note the microscopically enlarged photographs on the wall. Edison's main achievement with optics was the motion picture projector.

In order to sell large numbers of lamps, there needed to be a readily-accessible supply of electricity, so Edison concentrated on town supply systems. In 1881, Edison's company moved to New York City to promote the construction of electric power plants in cities.

Other companies were trying to get contracts to light the city but when Edison hosted the city politicians an electrically-lit dinner at Menlo Park, they were soon won over and work began, digging up New York streets for Edison's cables. Edison built the Pearl Street Station, a steam electric power plant in 1882, providing electricity to many customers.

Soon he established a training school for electrical engineers, who worked at the Pearl Street generating station and Edison's machine shops. One trainee was a young naval officer cadet, Sidney Mitchell, who had enjoyed the opportunity to assist installing and operating an incandescent lighting system on the USS Trenton – the Navy's first electric lighting system in a vessel. Mitchell learnt how to make dynamos and travelled around New York with the wiring squads. The installation of electricity in homes was rather like the roll-out of cable TV: first the electrical cables and associated connections had to be placed in trenches and past your house, before being able to connect up.

Mitchell learnt about power distribution, insulation, lamp sockets and power connections. In less than 12 months, Mitchell was offered the exclusive agency for Edison products in Northwest States. People in the northwest had heard of electricity and Mitchell believed if he established electrical power in one town, the others would want the same.

Initially they sold 250 lamps in Seattle and financed a company to build a small steam-generated power station and distribution system along the waterfront. Soon another 600 lamps were sold in Tacoma.

From these humble beginnings, the Edison General Electric Co. started the giant Pacific Power and Light Company, worth $836 million in 1970!

By the 1890s, hundreds of communities throughout the world had Edison power stations.

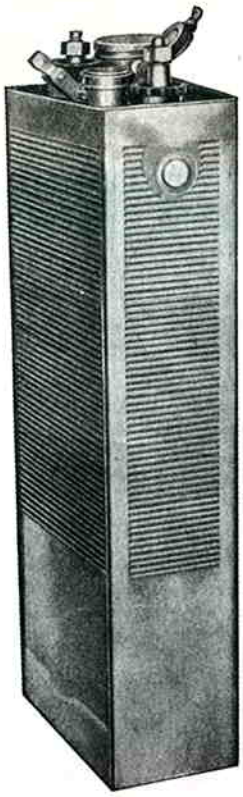
After investing in manufacturers and forming companies that produced generators, power cables, electric lamps and lighting fixtures, the General Electric Company was formed in 1892.

In New Jersey, he built a laboratory 10 times the size of his Menlo Park 'invention factory'. This lab had a three-story office, housing thousands of journals and books, space for mechanical, chemical and electrical experiments and later included facilities for manufacturing.

Motion pictures

Edison was a founder of the motion-picture industry. In 1888, he met British-born photographer Edward Muybridge, who was studying motion, by taking a rapid series of still photographs at a very high shutter speed. Projected on a spinning frame, the almost motion-picture effect inspired Edison to investigate the field. Edison planned a motion-picture device that looked like the cylinder phonograph, writing "I am experimenting upon an instrument which does for the Eye what the phonograph does for the Ear."

Edison and his lab photographer, WKL Dickson, began recording a series of images on celluloid film, then projecting them in rapid succession like continuous action. Over five years, Edison invented the peephole kinetoscope, the first practical motion-picture device that used a roll of film. It consisted of a cabinet with a peephole or eyepiece on top, displaying a 90-second film. The camera was called the kinetograph and employed George Eastman's 35mm sprocketed celluloid film, very similar to today's film.



Edison's 'Alkaline' batteries were more reliable, at a premium price. The 1911 model is shown here.

The first Kinetoscopes in Australia were exhibited in Sydney on 30th November 1894 and 'were shown in city after city to much acclaim'.

In 1893, Dickson built the all-black studio, nicknamed 'Black Maria'. Edison's motion-picture film studio was the first in the world, filming many people, performers and actors.

Few know that in 1908, Edison and most other movie inventors pooled their patents, forming the Motion Picture Patents Company, a virtual monopoly, controlling the production, distribution and exhibition of motion pictures for many years.

Finally, in 1917, the Supreme Court of the United States ruled the company was an illegal monopoly, reducing Edison's influence and opening the way for many other film companies.

Ore milling

Edison's inventions and businesses included interests in processing ore and Portland cement production. His ore processor featured giant electrically-operated magnets, to separate iron from iron ore.

The processing plant in northern New Jersey moved raw ore on conveyor belts, in a system like the assembly line later employed by Henry Ford.

Despite investing more than US $1,000,000 in ore milling and demonstrating it successfully, the project failed. It was hard to compete with the rich iron ore discovered in Minnesota, which was less expensive to mine and process.

Storage batteries.

Batteries were essential for communications, railroad systems, electric vehicles, starters for petrol-driven vehicles and much more, so the Edison factory was on a major quest to produce lighter, more durable and powerful batteries. They made outstanding progress.

If only electricity had prevailed, we would not have such a current demand for petrol.

In 1911, he was producing an 'alkaline' battery (named after the alkaline electrolyte – not the same as alkaline dry-cell batteries today). The positive plate had nickel-hydrate active material in perforated tubes and the negative plate active material was iron oxide, in perforated flat pockets.

The Alkaline battery was lighter and cleaner than the lead battery, at a premium cost. Other advantages included its light weight – about half the weight of a similar performance lead battery, much longer life and relative immunity to rapid discharge, full discharge, standing idle while charged or discharged, or overcharging. It was primarily marketed for electric vehicle work, with two models, rated at 40 and 80 ampere-hours. A gas valve prevented the loss of electrolyte during charging, plus reduced fuming; ensuring maintenance was only an occasional top-up with distilled water.

Portland Cement

One of Edison's companies began mass-producing Portland cement in the early 1900s.

The plant used some equipment from his failed ore project and was one of the biggest in the United States, located in western New Jersey. He introduced poured concrete houses and cement for large factories, plus supplied cement for buildings in New York city, like the Yankee Stadium. He also designed concrete furniture – even a phonograph cabinet made of ornate-design concrete.

Phonograph

Disk records were easier to produce and store than cylinder recordings. Reluctantly, Edison switched to the disk format in 1913. However, he continued to develop and later sold the Ediphone, a dictating machine based on his cylinder phonograph.

During the 1914-1918 World War, Edison produced chemicals, plus batteries for submarines. He offered many inventions but the Navy refused them all. Edison concluded they didn't like civilian interference!

Even in his eighties, Edison tested 3000 plants, to find another source of rubber. He found a suitable plant but by then factory-synthetic rubber was invented.

Edison was rarely ill and worked around the clock, believing most people ate and slept too much.

Edison was honoured by his friend, Henry Ford, who reconstructed Edison's lab in his museum complex. On completion, Edison inspected the building, complete with much of the equipment he used to make world-famous inventions.

After so much effort to perfectly recreate the entire lab, all attention focussed on Edison, when he commented "you have one thing wrong." He then wryly said, "my lab was always much messier!"

Edison was known by close friends for his story-telling and sense of humour but his strongest friendships were with business associates. Henry Ford became his strongest confidant and friend, joining Harvey Firestone and naturalist John Burroughs on camping trips.

Along with millions of references to Edison on the web, travellers today can see four major historical sites and museums: his birthplace in Milan, Ohio, winter home in Fort Myers, Florida and the restored Menlo Park laboratory, which Ford moved from New Jersey to Greenfield Village in Dearborn, Michigan.

The US National Park Service manages the Edison National Historic Site at West Orange, including Edison's West Orange laboratory and the inventor's home in Llewellyn Park.

Edison, the genius, died on October 18, 1931.

As a tribute to the most famous inventor who had changed the world, at President Hoover's request, the lights were extinguished for a short time at the White House and throughout the nation.

SC

References: www.aaa1.biz/sc.html

BENCHMARK Oct 2006

DICK SMITH ELECTRONICS

24-Range Mains Rated Digital Multimeter

Large 3.5 digit (2,000 count) LCD screen, max and data hold facilities, diode and continuity test. Covers ranges of AC/DC Volts, Amps and resistance. Cat II 600V safety rating. Includes protective holster.

Q 1563

$48

SAVE $20

DICK SMITH ELECTRONICS

Digital Sound Level Meter

This high quality, digital sound level meter provides both automatic and manual ranging and has an analogue style digital bargraph. Provides a wide measurement range of 40dB to 130dB SPL with A and C weighting. Suitable for setting up surround sound systems as well as accurate measuring of noise levels in factories, schools, offices, discos and auditoriums.

Q 1362

$98

SAVE $30

TARGUS

Making Your Mobile Life Easier®

90W Notebook Power Adaptor

Ideal solution for the user who needs a lightweight and slim form factor solution for power at home and in the office. M 9666

$97.87

75W Notebook Power Adaptor M 9665 **$88.74**

KERIO®

90W Auto/Air Adaptor

Power your notebook in a car or plane. Efficient, lightweight, built-in USB port. M 9694

$148

72W Auto/Air Adaptor M 9665 **$98**

Black USB Mains Power Supply

USB 'A' Type socket, ideal for MP3, PDA and digital cameras. M 9936

$29.98

USB Auto Adaptor

Ideal for MP3 players, PDAs and digital cameras. M 9939

$19.98

DICK SMITH ELECTRONICS

know-how to make it easy

Products also available through www.dse.com.au

Look what's HOT!

PAY TV/DVD IN 2 ROOMS!

Transmit signal up to 100m away.

NEW

SMARTCONNECT
2.4GHz
AV Sender/Receiver Pack
Watch and control movies from your DVD or VCR in another room. Wirelessly transmits AV signals up to 100m. Compatible with your current remote control. L 5965

$88

HOT PRICE!

A major advancement in battery technology is here!

eneloop
Ready to use Rechargeable battery
by **SANYO**

The CONVENIENCE of extremely low self-discharge and the excellent storage life of alkaline, combined with the SAVINGS and PERFORMANCE of NiMH rechargeables.

- Ready to use straight from the packet (no pre-charging required).
- Excellent charge retention (85% capacity after 12 months storage).
- Lasts up to 4 times longer than alkaline in high-drain devices (eg. digital cameras).
- Can be recharged up to 1000 times (saving you hundreds of dollars in replacement single use disposable batteries).
- AA size typically 2000mAh, AAA size typically 800mAh.

From $12.99

Packs of 2 x AA or 2 x AAA S 4411 & S 4413 **$12.99 each**
Packs of 4 x AA or 4 x AAA S 4410 & S 4412 **$24.99 each**

DICK SMITH ELECTRONICS

4-Piece Security Torx Wrench Set
High quality security Torx style double-ended wrenches made from super-hard S2-grade steel alloy with polished satin-finish shafts. Sizes include T10, T15, T20, and T25, with shaft lengths of 100-120mm. T 6339

1 YEAR WARRANTY

$19.99 NEW

DICK SMITH ELECTRONICS

30-Piece Mini Bit Set with Handle
High quality 4mm mini bits made from super-hard S2 grade steel alloy. Includes extension shaft and quality handle with metal threaded tightening section. T 6337

$19.99 NEW

Promotion from 27/9/06 to 24/10/06

DICK SMITH ELECTRONICS
know·how to make it easy

Kit clearance time

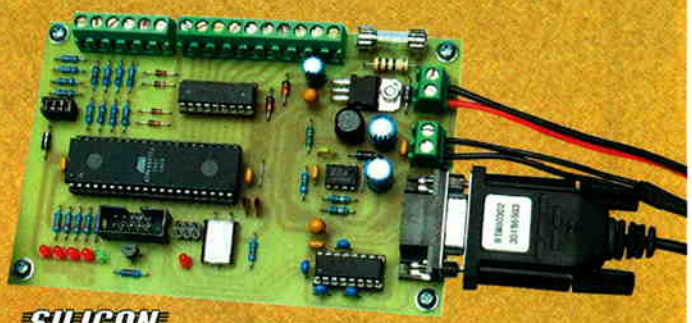
SILICON CHIP

Bilge Sniffer Kit

Designed to detect a buildup of flammable vapours which when mixed with air can present a significant hazard for explosion or fire.The circuit is designed around a hydrocarbon gas sensor (#MQ-6). It's suitable for detecting hydrocarbon gases emitted from engine fuels (petrol or diesel) or propane gases that is used for fueling stoves or barbecues. The kit is supplied with all specified components and hardware, printed circuit board, plastic case, a pre-punched and screen printed metal front panel and a tiny satellite PCB that will enable the constructor to mount the sensor remotely from the main unit. K 4615

$29.98

SAVE $20



SILICON CHIP

SMS I/O Controller Kit

Using the convenience of SMS, this project lets you remotely control equipment by sending plain text messages. Control pumps on a farm, switch home appliances on or off, reboot a server, monitor an alarm panel or simply locate your car in the car park. Compatible with Nokia brand phones such as 3210, 3310, 5110 and 6110. K 7221

$49.98

SAVE $29.82

Bass Extender Kit

Adds as much as an extra octave of bass response from your existing hi-fi speakers, circuit can be configured for a loudspeaker in either a vented or sealed enclosure, maximum input signal handling level of 2.5V RMS at 12V DC supply. K 5592

$9.98

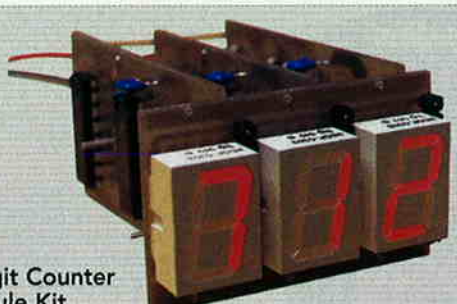
SAVE $5

Battery Charger Regulator Kit

Turns a 'bare bones' 12V automotive battery charger into a fully regulated charger. Designed to adapt an Arlec 4 charger or similar unit. Supplied with components, PCB and heatsink bracket case optional. K 3127

$14.98

SAVE $9.96



3-Digit Counter Module Kit

Expandable to as many digits as you like. Control inputs include lamp test, blanking, output latching, up/down count, in-put gating, reset and clock. Supplied with components, PCB and displays. K 3452

$19.98

SAVE $12.52

SILICON CHIP

Meter Level Kit

Perfect for precisely adjusting speaker levels when setting up a home theatre system, with built-in microphone and bargraph display. Supplied with PCB and all necessary components. K 5624

$19.98

SAVE $9.89

DICK SMITH ELECTRONICS

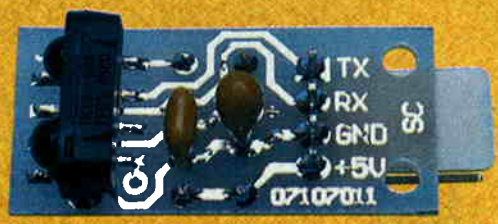
know·how to make it easy

www.dse.com.au

means big savings

Automatic Light Dimmer Kit
The Automatic Lamp Dimmer uses a pre-programmed infrared remote control to perform various functions. On and off control with soft start for long lamp life. Fast and slow dim up and dim down control. Automatic dim up and dim down. Programmable automatic dimming rate. Dimming level and dimming rate kept even after a blackout. Four remote control codes available. Suitable for lamps with a rating of 40W to 150W (max). K 3040

$29.98
SAVE $30



PC Infrared Port Kit
Build this super simple transceiver and add IR capability to your PC. Supplied with PCB and all components. K 3608

$14.98
SAVE $6.96

VHF FM/AM Radio Kit
Easy-to-build VHF receiver with slope detection for FM stations. Also receives local VHF AM airport radio services. Supplied with all necessary components. K 5015

$9.98
SAVE $4.96

SILICON CHIP

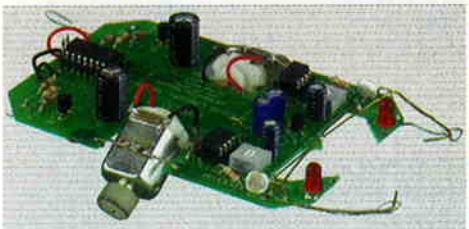
Remote Relay Box Kit
One of the simplest projects around, it's basically a power supply with a switching relay. The switching relay together with the mains input and output lead is rated at 240VAC @ 10A. K 3041

$19.98
SAVE $14.82

SILICON CHIP

DC-DC Converter Kit
Versatile circuit allows you to run a notebook in your car, charge SLA batteries (6.5Ah or bigger) or run 24V equipment from a 12V battery. Maximum current is 2A. K 3234

$29.98
SAVE $19.96



Cybug Robot Kit
Make an intelligent mechanical insect, senses and moves away from objects, can seek or avoid light and comes with high quality PCB and all components. K 3560

$49.98
SAVE $15.90

IN-STORE NOW!

Silicon Chip Magazine

Get your copy every month from your local Dick Smith Electronics store B 5020

$8.50

Terms and conditions: Offers start 27/09/06 and ends 24/10/06 or while stocks last. No rainchecks. No layby. Offers may not be available in some reseller or franchise stores.

Promotion from 27/9/06 to 24/10/06

DICK SMITH ELECTRONICS
know·how to make it easy

Loads of handy

DICK SMITH ELECTRONICS

Pocket Digital pH Meter
A pocket-sized pH meter with Auto Temperature Compensation, selectable °C/°F readout, Data Hold and a simple calibration process. Measures pH values from 0 to 14 with +/- 0.2pH accuracy, as well as temperature readings (accuracy of +/-1°C). Q 1391

$39.90
SAVE $10

DICK SMITH ELECTRONICS

Wide Range Infrared Thermometer with Laser Marker
Laser targeting, precision non-contact measurements, LCD screen with backlight, °C/°F selectable. Provides -50°C to 530°C measurements, with tight 8:1 distance to spot ratio. Q 1370

$98
SAVE $30

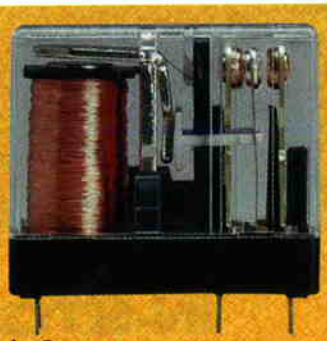
DICK SMITH ELECTRONICS

1000A AC/DC True RMS Digital Clamp Meter
Features a 4000 count bar graph display, AC/DC current range to 1000A, data hold, MAX/MIN hold and peak hold. Safety rating of Cat III 1000V. Q 1476

$138
SAVE $30

6mm x 25mm Mercury "Tilt" Switch
Voltage Range: 1.2VDC -14VDC
Current Range: 30mA -1A
P 7860
NORMALLY $2.04

99¢
SAVE 51%



Single Contact Changeover Switching PCB Relay
12V coil.
240V 10A contact.
P 8010
NORMALLY $9.98

$4.98
SAVE $5

Double Contact Changeover Switching PCB Relay
12V coil.
240V 5A contact.
P 8012
NORMALLY $10.98

$5.98
SAVE $5

12V Miniature Bi-Pin Globe
P 8158
NORMALLY $1.98

99¢
SAVE 50%

DICK SMITH ELECTRONICS

Adjustable Temperature Soldering Station
Lightweight handle with burn resistant cable, 250°C to 450°C temp range, 240V powered, with 1.6mm tip and cleaning sponge.
T 1976

$49.98
SAVE $20

DICK SMITH ELECTRONICS
know-how to make it easy

Products also available through www.dse.com.au

ideas for all!

DICK SMITH ELECTRONICS

Lab Power Supply 0-30V 2.5 Amp Digital Display

Laboratory grade linear power supply with 0-30V adjustable output and an adjustable continuous current from 0A to 2.5A at all selectable output voltages. Features separate voltage and current metering, overload protection and high/low current front panel terminals. **Q 1770**

$98

SAVE $50

DICK SMITH ELECTRONICS

10MHz Single Channel Oscilloscope with CRO Probe

At last an economical and easily transportable oscilloscope with bandwidth of up to 10MHz and sensitivity of 5mV/DIV to 5V/DIV. Easy to operate, it is an ideal scientific and engineering instrument for a wide range of uses including hobby and education. Supplied with a 1:1 and 10:1 switchable CRO probe and detailed instruction manual. **Q 1803**

$128

digitor

18V Cordless Drill

This powerful 18V cordless drill provides electronically controlled speed from 0 to 900rpm, forward and reverse switching with a lock off position and 17 torque settings. It includes a removable 18V 1.2Ah capacity NiCad battery pack, a 10mm keyless chuck, 3-5hr charging cradle with auto cut-off and approved AC adaptor/charger. **T 4868**

2 YEAR WARRANTY

$29.99

INCLUDES HANDY STORAGE/CARRY CASE

DICK SMITH ELECTRONICS

24V Heavy Duty Cordless Hammer Drill

This high power 24V cordless hammer drill is ideal for the serious DIY handyman or weekend renovation warrior. The 2-speed gearbox and smooth electronic speed control provides 0 to 500 or 0 to 1400rpm selection, while the large 13mm keyless chuck and 17 torque settings provide greater flexibility when selecting drill sizes. Includes 1hr fast charger, 24V 1.2Ah NiCd pack and accessories. **T 4870**

1 YEAR WARRANTY

$59.99

INCLUDES HANDY STORAGE/CARRY CASE

Available in-store or through our

Direct Sales Division

Phone: 1300 366 644 (Local call charge)

Fax: (02) 9642 9155

Mail: DICK SMITH ELECTRONICS
Direct Sales Reply Paid 500, PO Box 500,
Regents Park DC NSW 2143
(No stamp required)

Meterman

Voltage Detector

Make sure you test the mains circuits before working on them!

- Non-contact voltage tester.
- 70 -440V AC range.
- Audio and visual warning.

Q 1780

$34.99

Promotion from 27/9/06 to 24/10/06

DICK SMITH ELECTRONICS

know·how to make it easy

10743

DriveRight
carchip E/X
Take the guesswork out of diagnosing engine problems.
Wish you could read your car's mind?
Plugs instantly into your car or truck. Continuously logs performance.
Under the Hood
• Read diagnostic trouble codes.
• Clear your own check engine light.
• Log RPM, O2 sensors, coolant temp, fuel trim, &
Use with your PC for:
• Detailed Analysis
• Charting
• Graphing
300 hrs.
DriveRight
carchip E/X
Pat. Pending

CarChip E/X

A tiny data logger that plugs straight into your car

By JULIAN EDGAR

NOW HERE'S a brilliant device – it plugs into your car's standard On Board Diagnostics (OBD) port and then proceeds to log car data up to a maximum of 300 hours running. You can log parameters like road speed, RPM, oxygen sensor output and the airflow meter signal. Then you unplug the device from the car and connect it to your PC where you can easily graph and analyse the information, including quickly highlighting high acceleration and braking rates, maximum speeds and so on.

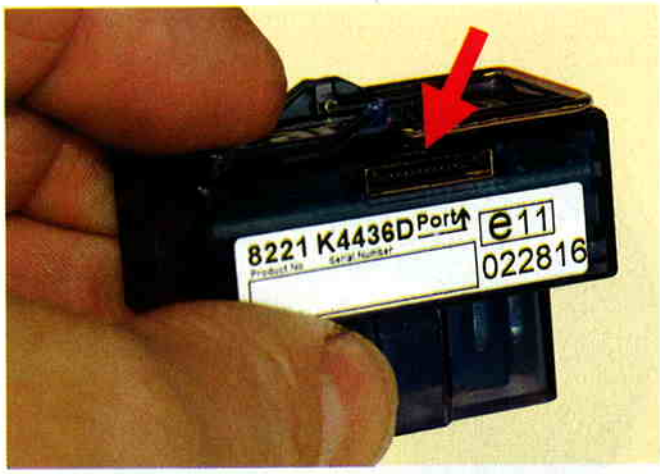
It's ideal for someone who wants to monitor how their car is being driven by others (parents of teenage drivers, anyone?) or to check on the health of engine management sensors. And talking about the latter, the device will also record fault codes and can then be used to clear them!

The CarChip E/X

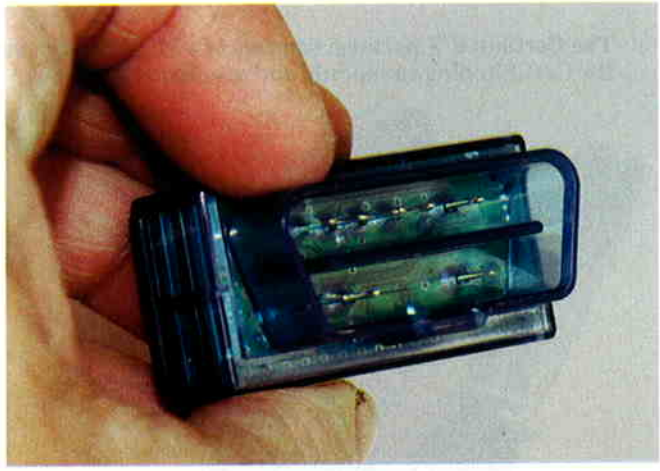
The CarChip E/X is only a bit bigger than the OBD socket itself. So what's an OBD socket then?

Mandated in the US about 10 years ago, the OBD port is a standardised diagnostics socket that allows the US authorities to quickly and easily diagnose engine management maladies that could cause the car to be no longer emissions legal. With the legislated requirement that the socket be fitted and that a standardised protocol be used (actually, a number of protocols are permitted), car manufacturers also adopted the system for their own diagnostics. However, the manufacturer-specific data is in addition to the OBD data. In other words, all cars sold in the US have an OBD socket with certain standardised information available from it, while manufacturer-specific diagnostics tools can access further information that pertains to just that model.

The CarChip E/X makes use of the universal OBD data – vehicle speed, engine speed, throttle position, coolant temperature, engine load, intake manifold pressure, airflow rate, intake air temp, ignition timing advance, fuel pressure, short-term fuel trim, long-term fuel trim, oxygen sensor voltage, battery voltage and fuel system status.



The PC interface cable plugs into this socket (arrowed) and connects the CarChip to the PC's USB port. Dedicated software is used to analyse and display the data.



The CarChip E/X plugs straight into the OBD port now found on most cars. It continuously logs data that can include speed, throttle position and engine RPM.

Note that many cars will not support all of these parameters (for example, a car with a MAP sensor will not support airflow rate), so this is the maximum possible list of parameters able to be generically read from the OBD port. At any one time, a maximum of four parameters is able to be logged by the CarChip E/X.

Configuring the CarChip E/X

After the software is loaded on the PC, the CarChip E/X is connected via a dedicated USB adaptor cable. A "Walkthrough Setup" procedure is then initiated that allows the user to select metric or imperial units, the name of the vehicle and driver, the CarChip serial number and whether the data is automatically cleared from the CarChip when it is downloaded to the PC. Under the "Choose Other Parameters" tab, you can set what parameters you want logged. These can be set to be logged at 5, 10, 20, 30 or 60-second intervals.

Thresholds can also be set for what is defined by the data analysis software as hard braking, extreme braking, hard acceleration, extreme acceleration and various speed bands. The braking and acceleration levels are presumably determined by the change of speed over time.

The software is largely self-explanatory and is quite easy to use.

Installation

Installation of the CarChip E/X in the car takes only a few seconds.

Step 1 is to locate the OBD socket. By regulation this must be positioned near the steering wheel and it's also required that it be accessible without tools. Common positions include under the steering column, under a trim panel in the centre console or up under the dash.

Step 2 is to plug the CarChip E/X into the OBD socket.

Step 3 is to start the car and make sure the data logger indicator LED on the device is flashing (if this LED is distracting, it can be configured off in the software).

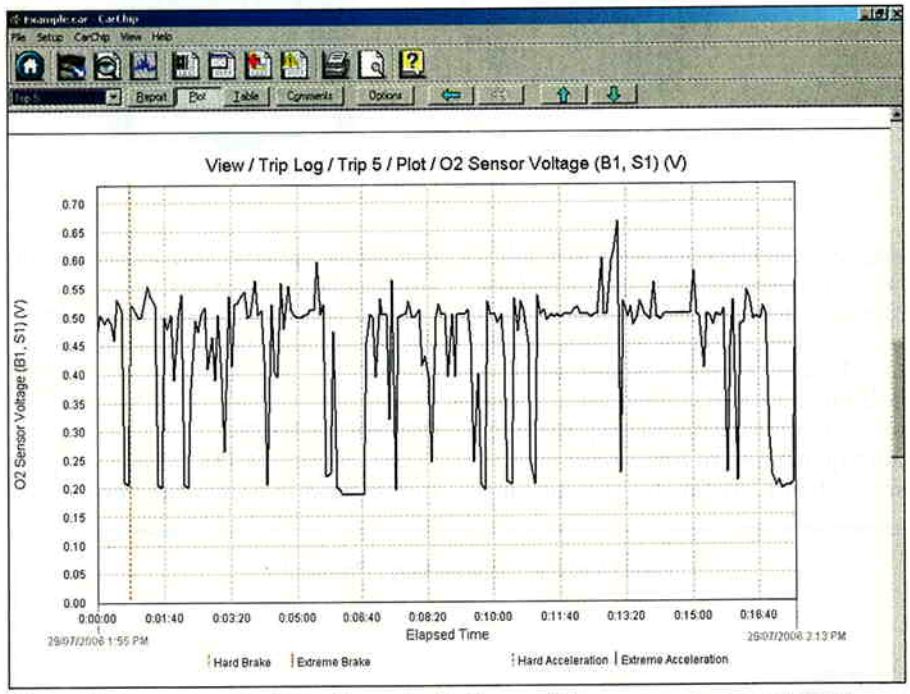


Fig.1: this screen grab shows the output of one of the oxygen sensors, logged over the trip shown in Fig.2. This shows that (a) the oxygen sensor is in good health (the output rapidly varies a great deal) and that (b) the car ran fairly lean mixtures for much of the time (output voltage mostly below 0.5V). Logging the short and long-term fuel trims would indicate if these mixtures were leaner than desirable – if they were (say because of a blocked fuel filter), the fuel trims would show major change.

And that's it for installation! The unit is now ready for use.

Analysing the Data

The CarChip E/X stores data for up to 300 hours of driving and then starts over-writing the oldest data. However, at any point, you can remove the device from the car and download the data to your PC which then displays it in the form of separate trips.

For each trip, you can display the

The CarChip E/X package consists of a PC interface cable, the CarChip plug-in module and a software CD.

logged parameters in graphical or tabular forms. In addition to the logged parameter, each graph also shows where acceleration and braking thresholds have been exceeded. A report can then be brought up that shows various data, including the start and stop times of the trip, amount of time spent in each speed band, distance, average and maximum speeds, and hard braking and acceleration events.

Even a glance at this information will show how the vehicle has been driven.

Sensor graphs

The graphs of the sensor outputs can be used to assess the "health" of the sensors used in the vehicle. For example, the oxygen sensors used in most cars should show a swing from about 0-1V. A dead oxygen sensor will not only have a low voltage output but quick changes will also be absent.

However, for diagnostics, the first step should be to view the *Vehicle Trouble Log*. This displays any logged fault codes and significantly, also shows a snapshot of engine parameters at the time the fault code was logged. These parameters include intake manifold pressure, coolant temperature, calculated load value, engine speed, vehicle speed, short and long-term fuel trims, and whether the engine management system is working in open or closed-loop operation.

Note that these snapshot parameters are not dependent on the parameters you have chosen to log long-term.

It's important to realise that the logged trouble codes may be manufacturer-specific. The software gives a guide as to what each trouble code may mean but these are not always correct. Instead, it's best to use Google to determine the meaning of a trouble code (eg, "Honda Insight P1447") rather than relying on the suggestion. The software can also be configured to delete the trouble code but again, this may not be successful if the trouble code is manufacturer-specific.

View / Vehicle Trouble Log / Problem 1

Overview

Time	29/07/2006 12:57 PM
Vehicle	Honda Insight
CarChip	K-4436-D
Trouble Code	P1447
Description	Unknown Powertrain DTC (Manufacturer Controlled; Auxiliary Emission Controls)
Comments	

Engine Status

Fuel Pressure (Gage)	
Intake Manifold Pressure (Absolute)	26 kPa
Engine Coolant Temperature	90.00 °C
Calculated Load Value	25.9 %
Engine Speed	942 RPM
Vehicle Speed	0 kph

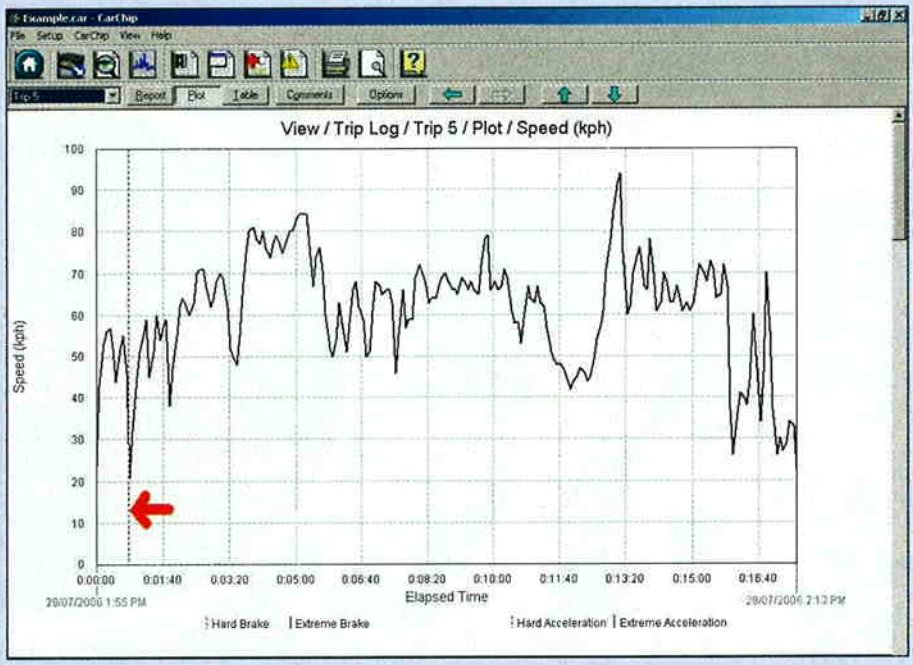
Fuel Trim Status

Short-Term Fuel Trim (Bank 1)	0.00 %
Short-Term Fuel Trim (Bank 2)	
Long-Term Fuel Trim (Bank 1)	0.00 %
Long-Term Fuel Trim (Bank 2)	

Fuel System Status

Fuel System 1 Status	
Fuel System 2 Status	Open loop; has not yet satisfied conditions to go to closed loop.

This report shows a logged trouble code. In addition to the trouble code number being cited (P1447), the report also shows the engine parameters at the time the code was logged. This information makes tracing intermittent faults much easier.



View / Trip Log / Trip 5 / Report

Driver	Julian
Vehicle	Honda Insight
VIN	-
CarChip	K-4436-D
Start Time	29/07/2006 1:55 PM
End Time	29/07/2006 2:13 PM
Duration	0:17:42
Idle	0:00:00
0 to 72 kph	0:14:56
74 to 97 kph	0:02:45
98 to 113 kph	0:00:00
Over 114 kph	0:00:00
Distance	17.9 km
Average Speed	61 kph
Maximum Speed	97 kph
Hard Brakes	1 (Between 0.34 G and 0.51 G)
Extreme Brakes	0 (Over 0.51 G)
Hard Accelerations	0 (Between 0.31 G and 0.45 G)
Extreme Accelerations	0 (Over 0.45 G)
Parameters	
Parameter 1	Vehicle Speed Every 5 Seconds
Parameter 2	Timing Advance Every 5 Seconds
Parameter 3	O2 Sensor Voltage (B1, S1) Every 5 Seconds
Parameter 4	Intake Manifold Pressure Every 5 Seconds
Parameter 5	Engine Load Every 5 Seconds
Comments	

Fig.2: this screen grab shows the speed log of one trip. The timings on the horizontal axis show that the trip started at 1:55pm on July 29 and finished at 2:13pm. The vertical red trace (arrowed) indicates a hard braking event. The threshold for this (as well as extreme braking, hard acceleration and extreme acceleration) can be user-set. At right is the report for the same trip. At a glance, it can be seen that there was one hard braking event, no hard acceleration, most of the time was spent at less than 72km/h (in fact, the average speed was 61km/h) and the maximum speed was 97km/h. These reports are invaluable when driver behaviour needs to be monitored.

The software also includes the ability to replay the vehicle speed for the 18 seconds prior to a sudden stop. The software calls this an "Accident Log" and it may be useful where the vehicle is involved in an accident. However, for various reasons, we think such information would easily be able to be challenged in a court of law.

Conclusion

The CarChip E/X costs $286 plus $7.70 postage. A cheaper version (the CarChip), with a shorter 75-hour logging capability, is available for $217.80.

For your money you get an effective and small data logger that can remain plugged into the car semi-permanently. It will clearly show how the car is being driven on each trip. It also reads fault codes and is able to clear some of them. Furthermore, if you need to monitor sensor outputs (useful if the car is being modified), then the CarChip will do that as well.

For further information, contact Ecowatch on (03) 97617040 or browse to their website at **www.davisinstruments.com.au.** SC

Will It Fit My Car?

The first step in determining whether the CarChip will work with your car is to see if it has an OBD port. However, that is not the end of the matter. Many cars sold in Australia were produced with an OBD port but the internal ECU software to output OBD data was not enabled. For example, Toyota and Lexus models of around 1988-1990 have an OBD port but OBD readers will not work with them.

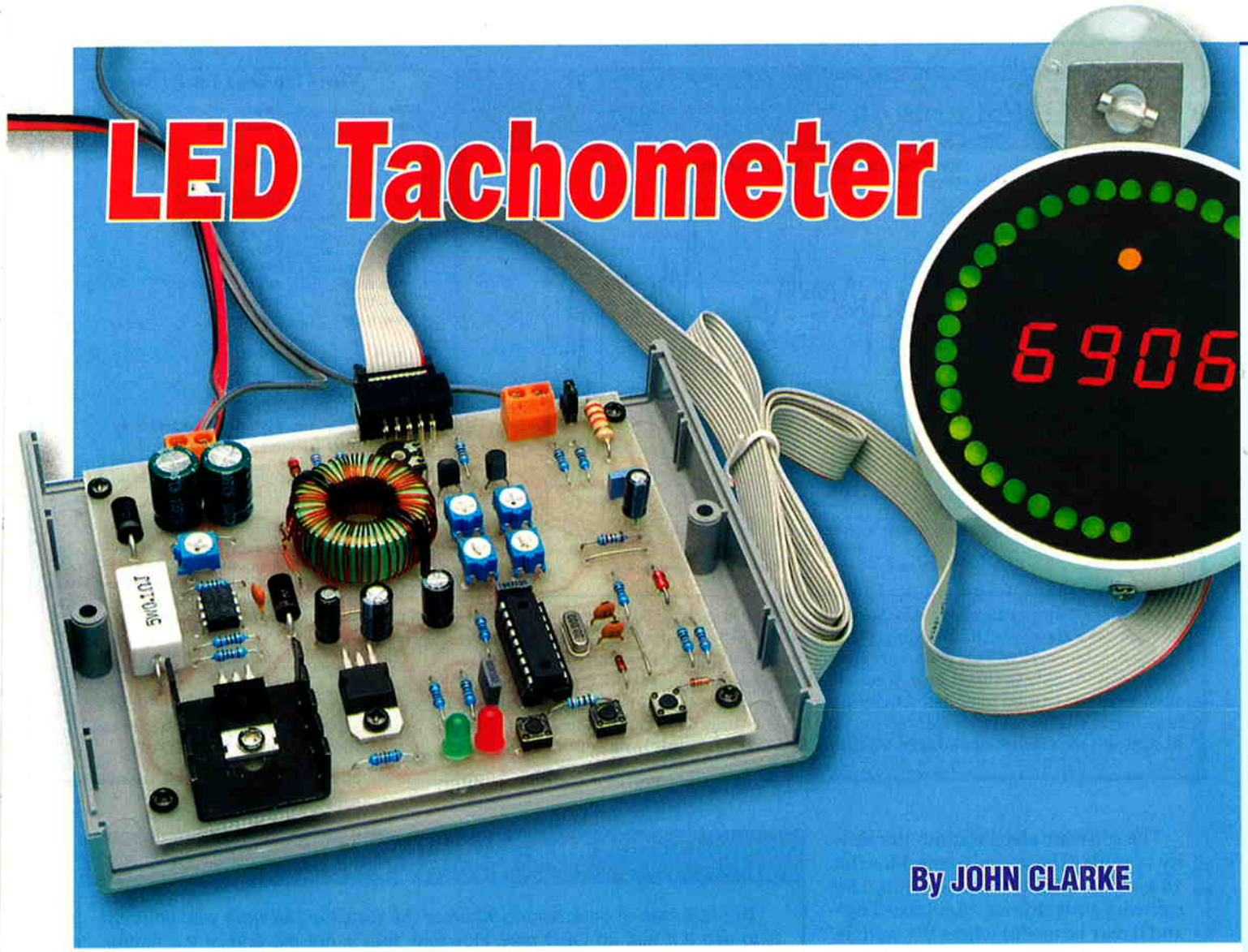
Cars produced after about 1991 that have an OBD port and which were also sold in the US are highly likely to have OBD capability. Australian-built cars with an OBD port may or may not have OBD capability. Again, the more recent the car, the more likely an OBD reader will work.

The CarChip works with the following OBD protocols: J1850-41.6, J1850-10.4, ISO9141, KWP2000 and CAN.

Issues Getting Dog-Eared? *Keep your copies safe with our handy binders*

Available Aust, only. Price: $A12.95 plus $7 p&p per order (includes GST). Just fill in and mail the handy order form in this issue; or ring (02) 9939 3295 and quote your credit card number; or fax your order with credit card details to (02) 99392648.

LED Tachometer



By JOHN CLARKE

A responsive and accurate tachometer is essential for motoring enthusiasts. This new unit features a bright 4-digit display plus a 32-LED circular bargraph. The LED bargraph responds rapidly to changes in RPM while the digital display shows accurate RPM readings with a steady throttle.

DIGITAL TACHOMETERS might be accurate but they don't respond like an analog instrument. This new SILICON CHIP tachometer combines the best features of analog and digital instruments: blip the throttle and the LED bargraph rapidly responds to the change in engine revs while the true RPM will be shown on the 4-digit display with up to 1 RPM resolution.

A gear shift light and a rev limiter output are standard features and it can operate with virtually any car or motorcycle (except magneto ignition). Its vast array of optional setting adjustments makes this tachometer a truly versatile instrument. For performance cars and motorcycles, this versatility includes the ability to display engine RPM above 10,000 RPM.

The circular display section of the tachometer has been made as small as is practical and it can be installed within the instrument cluster of your car if there is sufficient space available. Alternatively, it can be housed in a cylindrical case and mounted using a suitable holder on the dashboard, windscreen or instrument cluster. The main electronics part of the tachometer needs to be mounted under the dashboard (or within a side cover in a motorcycle).

The LED bargraph is arranged in a 76mm diameter circle that covers a 286° span. Most of the 32 LEDs are green except for the extreme clockwise end which uses five red LEDs to indicate the "red line" RPM. You can increase the "red line" indication to as many as 10 LEDs.

During calibration, the red line RPM

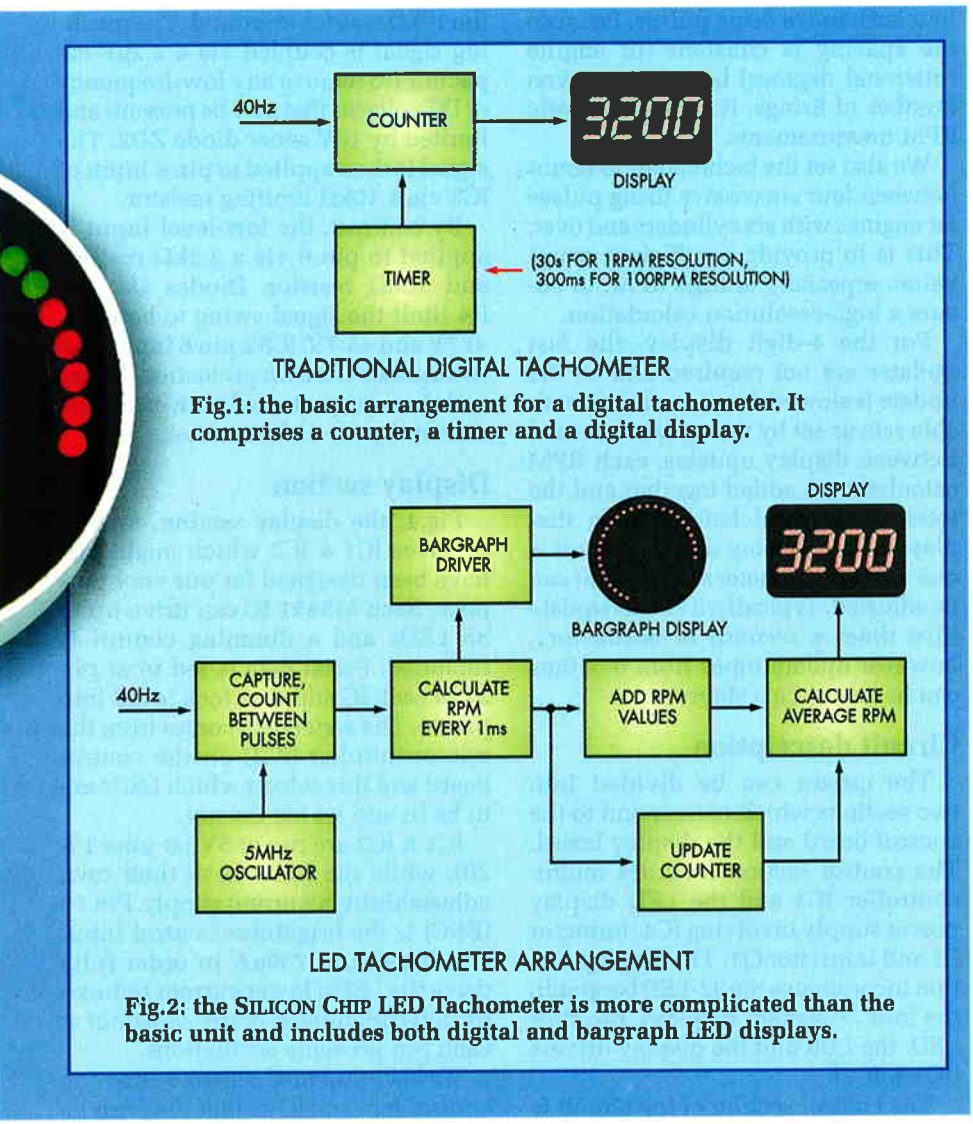


Fig.1: the basic arrangement for a digital tachometer. It comprises a counter, a timer and a digital display.

Fig.2: the SILICON CHIP LED Tachometer is more complicated than the basic unit and includes both digital and bargraph LED displays.

can be selected, as well as the number of red line LEDs. The tachometer then automatically calculates the RPM increments required to light each LED.

The shift light RPM can also be entered into the tachometer during the setting up procedure. If you do not want the shift light LED to operate, you can enter an RPM setting higher than the engine will reach.

The rev limiter output from the tachometer can be used to prevent the engine from over-revving if say, you miss a gear. However, the limiter action is very abrupt and is not suitable for normal speed or RPM restriction. The limiter output controls an external cutout circuit that works by "killing" the ignition or interrupting fuel to the injectors. We will discuss these options in Pt.2, next month.

Setting up the tachometer is easy as we use the digital display to show the options and the current settings, while you set the number of cylinders and lots other settings using pushbutton switches.

Basic digital tachometer

Fig.1 shows the basic arrangement for a typical digital tachometer. It comprises a counter, a timer and a digital display. For a 4-cylinder 4-stroke engine, there are two sparks or firing pulses per engine revolution. A 40Hz pulse signal from the engine therefore corresponds to 1200 RPM (40 x 60/2).

If we want the display to show 1200, we can do this in several ways. First, we can wait 30 seconds so that the counter reaches a count of 1200 but this is far too long to be practical.

A more practical method is to count the incoming signal over a 300ms period. This would allow the counter to reach 12 after 300ms. The display would then show a 12 and two more zeros could be added after the 12 to make it display 1200. These last two digits will always be set at zero and so the resolution is only 100 RPM. The resulting 300ms update time (ie, three times a second) is probably fine for a digital display because we would not be able to read it if it changed at a much faster rate. (We described a digital tachometer along these lines in the August 1991 issue).

However, if we add a multi-LED bargraph to the tachometer, then the 300ms update period would prevent the bargraph from rapidly responding to changes in engine revs; a quick blip of the throttle would probably not even be registered. The other problem with the 300ms update period is that it only has 100-RPM resolution and so the increments on the circular display would not be very precise.

The solution

Clearly, a tachometer with a bargraph that has many steps will need a much faster and more accurate means of measuring RPM. Fig.2 is the solution. Essentially, we have a high-speed oscillator running at 5MHz and this frequency is counted and then captured for the period between firing pulses. For a 40Hz input we would have 40 firing pulses every second and the counter would count up to 125,000 (5,000,000/40) between pulses. The value of 125,000 may not appear to be of much use but if we divide this number into 150 million we get the correct 1200 RPM reading for a 4-cylinder 4-stroke engine. The resolution is 1 RPM.

We can use a different numerator for the division calculation for each type of engine. For example, for a twin cylinder 4-stroke engine we use a value of 300 million for the numerator. In this case, a 40Hz signal would give a reading of 2400 RPM.

The RPM calculations are repeated every 1ms and a new RPM reading will be obtained if the captured count value is different from the previous count. The actual rate at which the RPM is updated is dependent on the time period between the firing pulses. For the 40Hz signal, we have an RPM update 40 times per second or once every 25ms. This is 12-times faster than the RPM measurement described in Fig.1. At higher RPM, the update time is even quicker. With a 100Hz signal (equivalent to 3000 RPM for a

Main features

- Fast 32-LED circular bargraph
- Dot or bargraph option
- 4-digit display
- Gear shift indicator LED
- Limiter signal output
- Display from 0-9999 RPM or above 10,000 RPM (optional)
- Two display options for RPM above 9999 RPM
- Options for 1 RPM, 10 RPM or 100 RPM display resolution
- Automatic display dimming in low ambient light
- Set-up for 1, 2, 3, 4, 5, 6, 8, 10 & 12-cylinder 4-stroke engines and 1, 2, 3, 4, 5 & 6-cylinder 2-stroke engines
- Selectable red line RPM
- Selectable shift light RPM
- Selectable limiter RPM
- Selectable number of red line LEDs
- Selectable display update period
- Selectable RPM hysteresis for LED bargraph
- Selectable limiter minimum on time

4-cylinder 4-stroke engine), the RPM reading is updated every 10ms or 100 times per second.

Note that because the calculation of RPM is made every 1ms, the new RPM value is available almost as soon as the counter value has been captured. The resulting RPM value is sent to the bargraph driver to display the latest reading.

Twin-cylinder motorbikes

One small problem with this method of RPM measurement is that it does not work with engines that have uneven firing between cylinders. It would measure two different RPM readings because of the uneven spacing between successive firing pulses. This is mainly a concern with twin-cylinder 4-stroke engines with cylinder separations of less than 180°, such as from Harley Davidson, Ducati and Moto Guzzi.

To prevent this reading problem, we have included setting selections for these engines that count between four successive firing pulses. Because the spacing is constant (in engine rotational degrees) between an even number of firings, it prevents erratic RPM measurements.

We also set the tachometer to count between four successive firing pulses for engines with six cylinders and over. This is to provide a sufficient count value, especially at high RPM, to ensure a high-resolution calculation.

For the 4-digit display, the fast updates are not required and so the update is slowed down to a more readable rate as set by the update counter. Between display updates, each RPM calculation is added together and the total is averaged before being displayed. The display update period is one of the tachometer settings that can be adjusted. Typically, a 200ms update (five times a second) is satisfactory, however update times from 0-510ms can be set, in 2ms steps.

Circuit description

The circuit can be divided into two sections which correspond to the control board and the display board. The control section includes microcontroller IC3 and the LED display power supply involving IC4, inductor L1 and transistor Q1. The display section incorporates the 32-LED bargraph, the four 7-segment displays, the shift LED, the LDR and the display drivers (IC1 & IC2).

The control section of the circuit is shown in Fig.3. IC3 is the microcontroller that drives the data and clock lines for the display driver ICs. It also accepts the tachometer signal from the engine and performs the calculations required to display the RPM. Calibration and option settings are set using switches S1-S3, while LED34 and LED35 show the display status. IC3 operates at 20MHz, as set by the crystal X1.

The ignition signal from the engine can be obtained from the car's Engine Control Unit (ECU), from a reluctor, Hall effect trigger or points, or via an ignition coil connection for cars that have a distributor. Two separate inputs are provided, a high level input for connecting to high-voltage signals such as from an ignition coil and reluctor and a low-level input for a low-voltage source such as the ECU.

The high-level signal is fed via an attenuation network consisting of a 22kΩ resistor, two 47nF capacitors and the 10kΩ resistor to ground. The resulting signal is coupled via a 2.2µF capacitor (to remove any low-frequency or DC voltages that may be present) and limited by 10V zener diode ZD2. The signal is then applied to pin 6 input of IC3 via a 10kΩ limiting resistor.

By contrast, the low-level input is applied to pin 6 via a 2.2kΩ resistor and 100Ω resistor. Diodes D3 and D4 limit the signal swing to between -0.7V and +5.7V. IC3's pin 6 input also incorporates its own protection diodes and these are protected from excessive current by the 100Ω resistor.

Display section

Fig.4, the display section, mainly involves IC1 & IC2 which might just have been designed for our very purpose. Each M5451 IC can drive up to 35 LEDs and a dimming control is included. Serial data is fed in at pin 22 of each IC and the clock is fed into pin 21. The serial data comes from the microcontroller (IC3) on the control board and this selects which LEDs are to be lit and which are not.

IC1 & IC2 are run at 5V (at pins 1 & 20), while the LEDs have their own adjustable high-current supply. Pin 19 (BRC) is the brightness control input and it requires 750µA in order fully drive the LEDs; lower current reduces the LED brightness. A 1nF capacitor at each pin prevents oscillations.

We have provided separate dimming control for each IC so that they can be adjusted to provide the same apparent brightness. The light dependent resistor (LDR1) controls the brightness.

Power

There are two power supply circuits, one to provide 5V for the ICs and the already mentioned LED supply which operates in switchmode to minimise heat dissipation. It comprises IC4, transistor Q1 and inductor L1 – see Fig.3.

IC4 is an MC34063 DC-DC converter which runs at around 40kHz to switch transistor Q1 on and off. Each time Q1 switches on, current builds through L1 until it reaches a peak of about 3A, as detected by the voltage drop across the 0.1Ω resistor between pin 6 & 7. When the current reaches 3A, Q1 switches off and the charge within L1 is allowed to continue to flow via diode D2. The resulting supply is filtered with a 470µF low-ESR capacitor.

Voltage feedback is provided via the

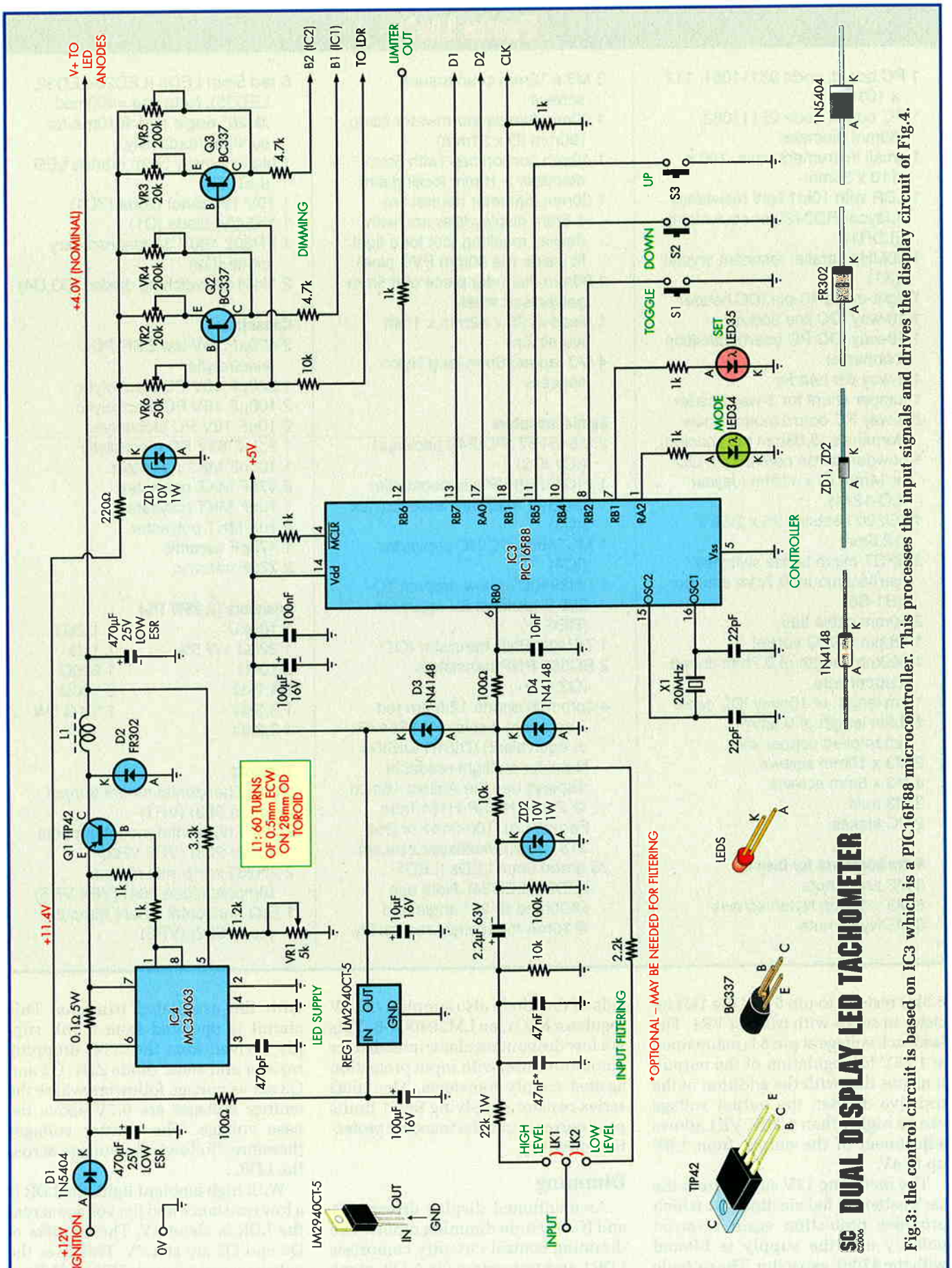


Fig.3: the control circuit is based on IC3 which is a PIC16F88 microcontroller. This processes the input signals and drives the display circuit of Fig.4.

Parts List

1 PC board, code 05111061, 117 x 101mm
1 PC board, code 05111062, 89mm diameter
1 small instrument case, 140 x 110 x 35mm
1 LDR with 10kΩ light resistance (Jaycar RD3480 or equivalent) (LDR1)
1 20MHz parallel resonant crystal (X1)
1 right-angle 10-pin IDC header
1 10-way IDC line socket
1 10-way IDC PC board transition connector
1 3-way pin header
1 jumper shunt for 3-way header
2 2-way PC board mount screw terminals (5.08mm pin spacing)
1 powdered iron core 28mm OD x 14mm ID x 11mm (Jaycar LO-1244)
1 TO220 heatsink 25 x 29.5 x 12.6mm
3 SPST micro tactile switches vertical mount 0.7mm actuator (S1-S3)
2 50mm cable ties
1 18-pin DIL IC socket
1 500mm length of 0.7mm tinned copper wire
1 1m length of 10-way IDC cable
1 3.5m length of 0.5mm enamelled copper wire
2 M3 x 10mm screws
4 M3 x 6mm screws
2 M3 nuts
2 PC stakes

Extra hardware for Display

3 M3 brass nuts
6 M3 x 12mm Nylon screws
6 M3 Nylon nuts
3 M3 x 12mm countersunk screws
1 90mm female stormwater fitting (90mm ID x 21mm)
1 40mm suction cap (with 5mm diameter x 15mm locking pin)
1 90mm diameter neutral-tint 1.5mm display filter and with display masking (cut for a tight fit inside the 90mm PVC pipe)
1 90mm diameter piece of 0.5mm galvanised steel
1 piece of 25 x 42mm x 1mm aluminium
4 M3 tapped 6mm long Nylon spacers

Semiconductors

2 M5451B7 (PDIP40 package) (IC1,IC2)
1 PIC16F88-I/P microcontroller programmed with ledtacho.hex (IC3)
1 MC34063 DC-DC converter (IC4)
1 LM2940CT-5 low dropout TO-220 3-terminal 5V regulator (REG1)
1 TIP42C PNP transistor (Q1)
2 BC557 PNP transistors (Q2,Q3)
4 common anode 12.5mm red 7-segment displays (LTS542R or equivalent) (DISP1-DISP4). Note: for sunlight readable displays use the Agilent 16mcd @ 20mA HDSP-H151 from Farnell Cat. 100-3141 or 264-313 (**www.farnellinone.com.au**).
28 green 5mm LEDs (LED1-LED27, LED34). Note use >400mcd @ 20° angle and @10mA for sunlight readability.
6 red 5mm LEDs (LED28-LED32, LED35). Note use >400mcd @ 20° angle and @10mA for sunlight readability.
1 high intensity 5mm orange LED (LED33)
1 10V 1W zener diode (ZD1)
1 1N5404 diode (D1)
1 FR302 100V 3A fast recovery diode (D2)
2 1N4148 switching diodes (D3,D4)

Capacitors

2 470µF 25V low ESR PC electrolytic
1 220µF 10V PC electrolytic
2 100µF 16V PC electrolytic
2 10µF 16V PC electrolytic
1 2.2µF 63V PC electrolytic
1 100nF MKT polyester
2 47nF MKT polyester
1 10nF MKT polyester
2 1nF MKT polyester
1 470pF ceramic
2 22pF ceramic

Resistors (0.25W 1%)

1 100kΩ
1 22kΩ 1W 5%
3 10kΩ
2 4.7kΩ
1 3.3kΩ
1 2.2kΩ
1 1.2kΩ
7 1kΩ
1 220Ω
2 100Ω
1 0.1Ω 5W

Trimpots

1 50kΩ horizontal mount trimpot (code 503) (VR1)
2 20kΩ horizontal mount trimpots (code 203) (VR2,VR3)
2 200kΩ horizontal mount trimpots (code 204) (VR4,VR5)
1 5kΩ horizontal mount trimpot (code 502) (VR6)

3.3kΩ resistor to pin 5 and the 1kΩ resistor in series with trimpot VR1. The feedback voltage at pin 5 is maintained at 1.25V for regulation of the output. It means that with the addition of the resistive divider, the output voltage can be higher than 1.25V. VR1 allows adjustment of the output from 1.8V up to 4V.

The incoming 12V supply from the car's battery is fed via diode D1 which provides protection again reversed polarity and the supply is filtered with the 470µF capacitor. The cathode side of the diode also supplies the 5V regulator REG1, an LM2940CT-5. This is a low dropout regulator intended for automotive use, with input protection against supply transients. The 100Ω series resistor supplying REG1 limits peak currents into the transient protection circuitry.

Dimming

As mentioned display drivers IC1 and IC2 include dimming inputs. The dimming control circuitry comprises LDR1 and transistors Q2 & Q3, along with the associated trimpots. This circuit is operated from a 10V supply derived from the 220Ω dropping resistor and zener diode ZD1. Q2 and Q3 act as voltage followers where the emitter voltages are 0.7V above the base voltage. The emitter voltages therefore "follow" the voltage across the LDR.

With high ambient light, the LDR is a low resistance and the voltage across the LDR is about 1V. The emitters of Q2 and Q3 are at 1.7V. This fixes the voltage across trimpots VR2 and VR3 at

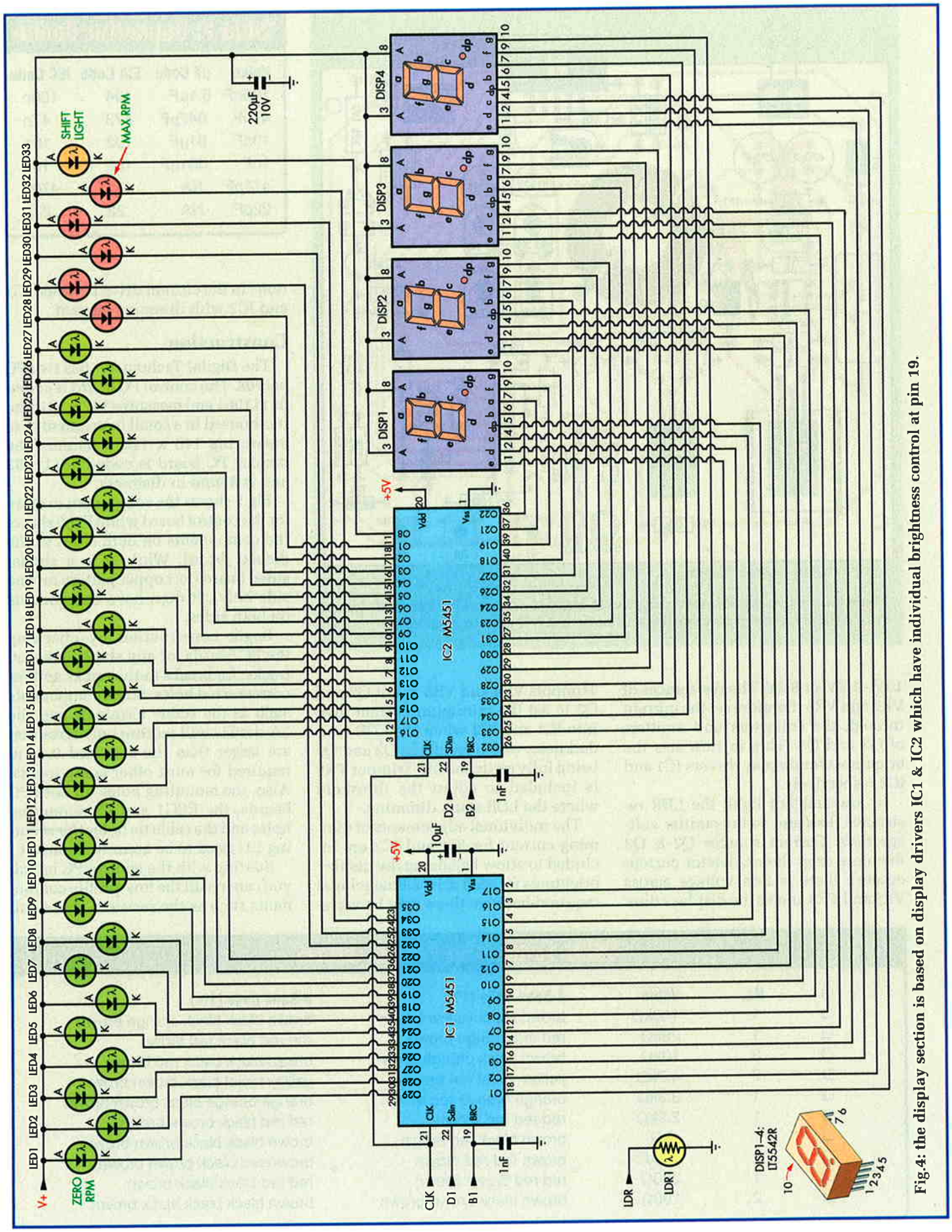


Fig.4: the display section is based on display drivers IC1 & IC2 which have individual brightness control at pin 19.

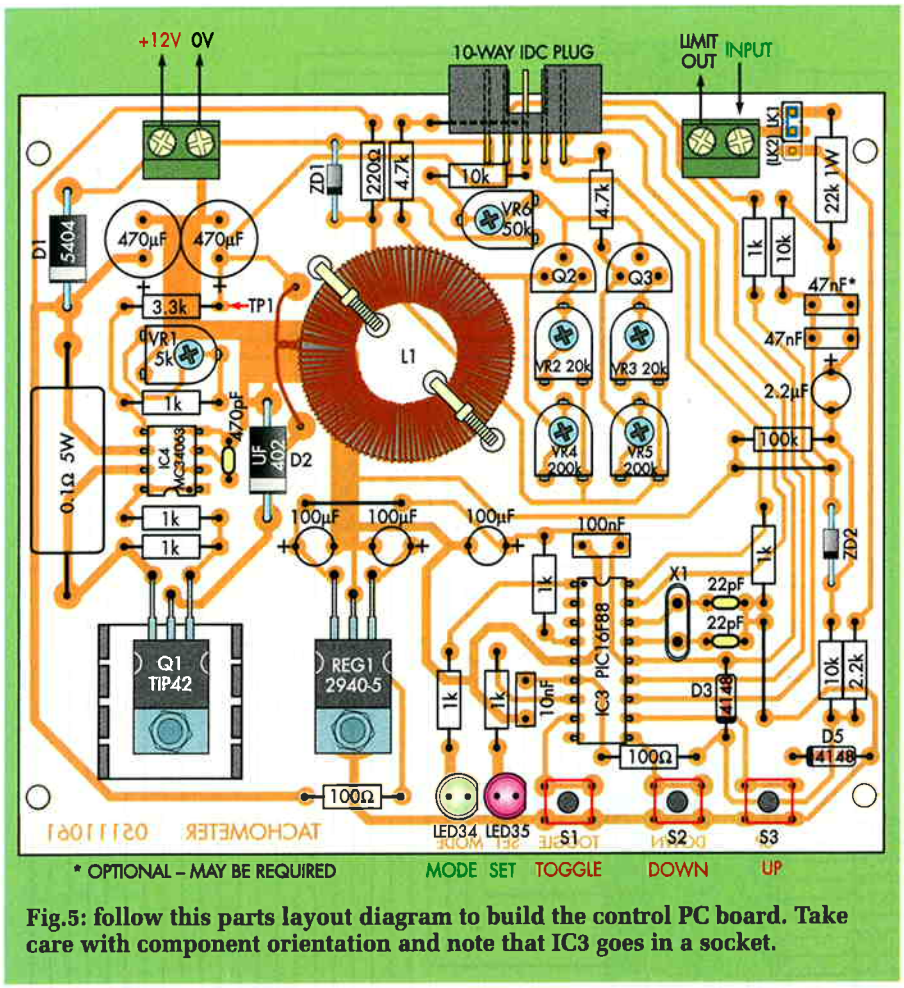


Fig.5: follow this parts layout diagram to build the control PC board. Take care with component orientation and note that IC3 goes in a socket.

10V - 1.7V, or 8.3V. The resistances of VR2 and VR3 therefore set the current through the collectors and emitters of Q2 and Q3. This in turn sets the brightness for display drivers IC1 and IC2 respectively.

In low ambient light, the LDR resistance rises and so the emitter voltage rises. Current sources Q2 & Q3 therefore drop their collector current because there is less voltage across VR2 and VR3 and so the displays dim.

Trimpots VR4 and VR5 shunt Q2 and Q3 to set the minimum current flow into IC1 and IC2 when the LDR is in darkness, which results in Q2 and Q3 being fully switched off. Trimpot VR6 is included to adjust the threshold where the LDR starts dimming.

The individual adjustments of dimming current for IC1 and IC2 are included to allow balancing the display brightness for each driver. Balancing is required because there may be variations in the current drive between IC1 and IC2 with dimming current.

Table 2: Capacitor Codes

Value	µF Code	EIA Code	IEC Code
100nF	0.1µF	104	100n
47nF	.047µF	473	47n
10nF	.01µF	103	10n
1nF	.001µF	102	1n0
470pF	NA	471	470p
22pF	NA	22	22p

Construction

The Digital Tachometer has two PC boards. The control PC board is coded 05111061 and measures 117 x 101mm. It is housed in a small instrument case measuring 140 x 110 x 35mm. The display PC board is coded 05111062 and is 89mm in diameter.

Fig.5 shows the component overlay for the control board while Fig.6 shows the components on both sides of the display board. While it is a single-sided board (ie, copper pattern on one side only), it does have components on both sides.

Begin construction by checking the PC boards for any shorts between tracks, for breaks in the tracks and for correct sized holes. Some components such as the screw terminals and the 3A diodes will require hole sizes that are larger than the standard 0.9mm required for most other components. Also, the mounting holes for both PC boards, the REG1 and Q1 mounting holes and the cable tie holes (for securing L1) need to be 3mm in diameter.

Starting with the control PC board, you can install the low-profile components such as the resistors, links and

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	100kΩ	brown black yellow brown	brown black black orange brown
❑	1	22kΩ	red red orange brown	red red black red brown
❑	3	10kΩ	brown black orange brown	brown black black red brown
❑	2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	1	3.3kΩ	orange orange red brown	orange orange black brown brown
❑	1	2.2kΩ	red red red brown	red red black brown brown
❑	7	1kΩ	brown black red brown	brown black black brown brown
❑	1	1.2kΩ	brown red red brown	brown red black brown brown
❑	1	220Ω	red red brown brown	red red black black brown
❑	2	100Ω	brown black brown brown	brown black black black brown

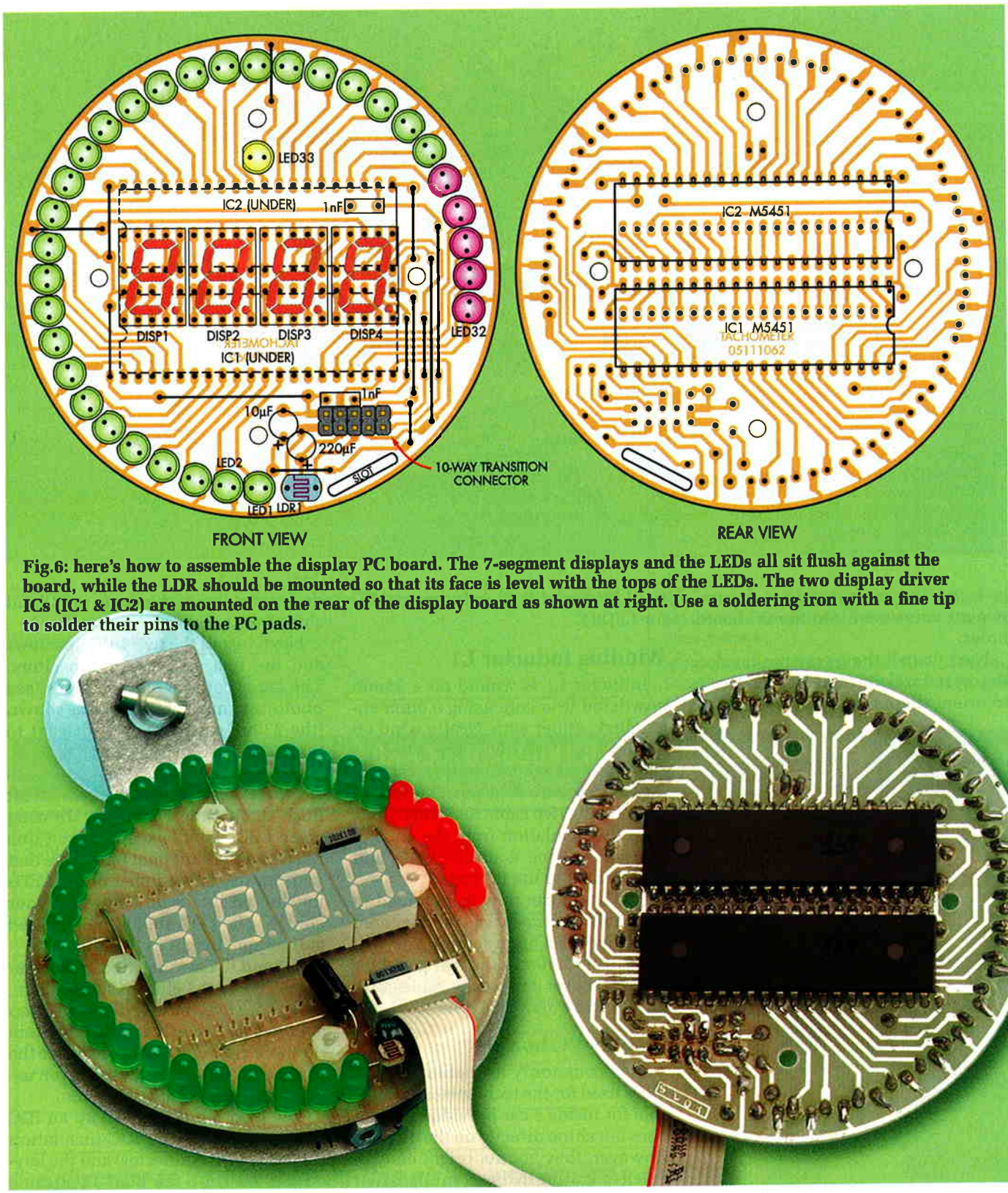


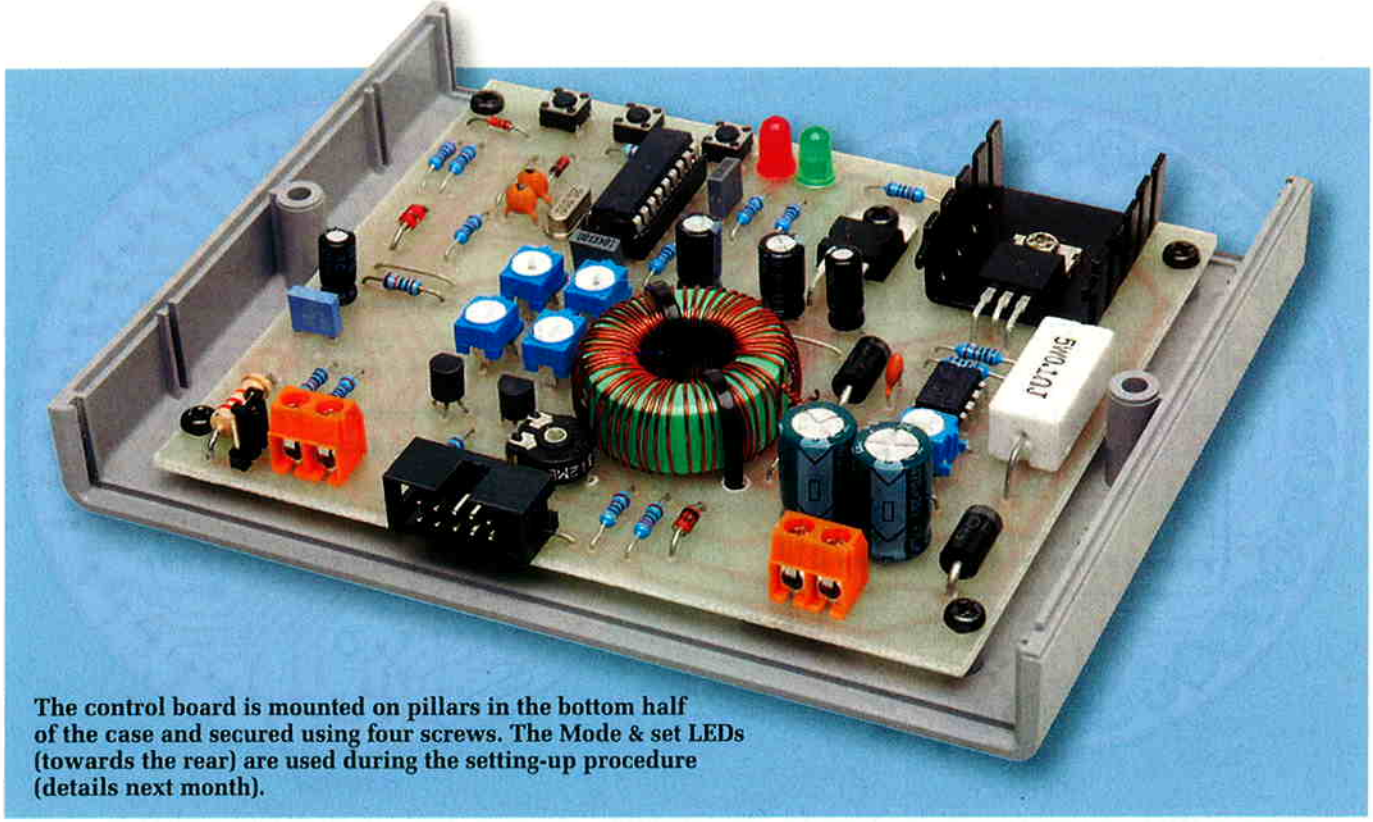
Fig.6: here's how to assemble the display PC board. The 7-segment displays and the LEDs all sit flush against the board, while the LDR should be mounted so that its face is level with the tops of the LEDs. The two display driver ICs (IC1 & IC2) are mounted on the rear of the display board as shown at right. Use a soldering iron with a fine tip to solder their pins to the PC pads.

ICs. Use Table 1 to select the resistors and check each value with a digital multimeter. IC3 is installed in a socket – make sure it goes in with the correct orientation.

The diodes can go in next, making sure that the orientation of each is correct. That done, install transistors Q2 and Q3, the trimpots and the switches. The 10-way IDC plug can then be installed, as well as the two 2-way screw terminal connectors.

Next, install the capacitors but note that the 47nF capacitor marked with the asterisk should be left out of circuit for the moment.

Both transistor Q1 and the regulator REG1 are mounted horizontally and secured with an M3 screw and nut to the PC board. Q1 is also mounted on the small heatsink. The leads can



The control board is mounted on pillars in the bottom half of the case and secured using four screws. The Mode & set LEDs (towards the rear) are used during the setting-up procedure (details next month).

be bent using pliers before each component is inserted into the PC board holes.

Next, install the 3-way pin header, the crystal and the two LEDs (take care to orient these correctly). We used a red LED for LED35 and a green LED for LED34.

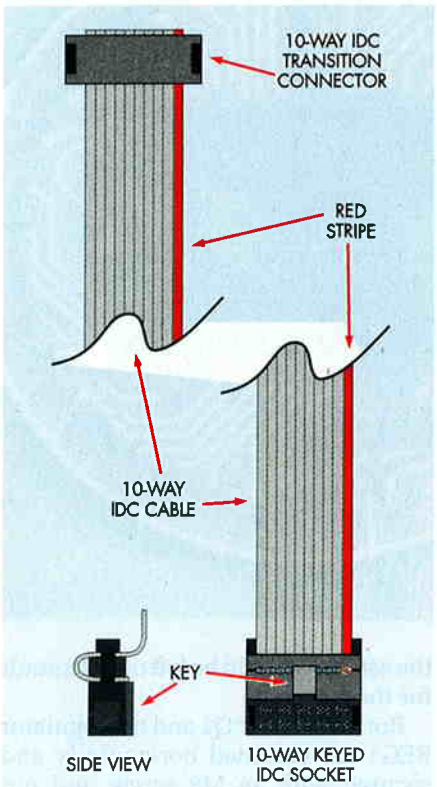


Fig.7: here's how to assemble the IDC lead.

Winding inductor L1

Inductor L1 is wound on a 28mm powdered iron core using 0.5mm enamelled copper wire. Neatly wind on the 60 turns and twist the wires together to prevent the windings loosening, then secure it in position on the board using two cable ties. That done, strip the insulation from the ends of the wires using a utility knife and solder them to the PC board.

The board can now be mounted in the small instrument case and secured with four M3 x 6mm screws. You will need to cut holes in the rear panel for the IDC socket and for the cable entry for the screw terminal points.

Display PC board

The commonly-available display LEDs used for the tachometer are suitable for inside a car provided the sun does not shine directly on the display. However, they are not bright enough when operating in direct sunlight. For this you will need sunlight-readable 7-segment displays and high-intensity LEDs. The parts list has the details.

Begin the assembly by installing all the wire links. Keep these straight and tight so that they will not short against each other. That done, install the 7-segment LED displays with the decimal points at the lower righthand side of each display.

Next, install the two 1nF capacitors and the two electrolytic capacitors. The latter both lie on their sides (see photo) and must be oriented as shown (the 220µF capacitor lies adjacent to the 10-way IDC connector).

Now install all the LEDs, taking care to orient these correctly. These all sit flush against the PC board. We used green LEDs for all except the red line LEDs and the shift light LED. Note that you can use any number of red LEDs for the red line from 0-10 – it's your choice. The LDR should be installed at the same height as the LEDs.

IC1 and IC2 are installed on the rear of the PC board. Before installing them, make sure that the displays have been soldered in correctly and that there are no shorts between pads. Now place the ICs in position and solder each pin using a fine-tipped soldering iron.

The next job is to make up an IDC lead using a 10-way IDC (insulation displacement connector) and the keyed IDC socket – see Fig.7. The cable is inserted into the IDC which is then squeezed together using a vice or clamp. Install the transition connector on the display PC board.

That's all for this month. In Pt.2, we'll finish the construction, describe the test and set-up procedures and give some hints on installation. **SC**

SILICON CHIP

www.siliconchip.com.au

Order Form/Tax Invoice

Silicon Chip Publications Pty Ltd
ABN 49 003 205 490

YOUR DETAILS

Your Name_____
(PLEASE PRINT)

Organisation (if applicable)_____

Address_____

_____

Postcode_____ **Daytime Phone No. ( )**_____

Email address (if applicable)_____

Method of Payment:

❑ Cheque/Money Order ❑ Bankcard ❑ Visa Card ❑ Master Card

Card No. |_|_|_|_| |_|_|_|_| |_|_|_|_| |_|_|_|_|

Card expiry date: |_|_|/|_|_|

Signature_____

PRICE GUIDE: SUBSCRIPTIONS

(Note: all subscription prices include P&P). (Aust. prices include GST)

Please state month to start.

Australia: 1 yr	$A83	2 yrs	$A160
1 yr + binder	$A96.50	2 yrs + 2 binders	$A186
NZ (air): 1 yr	$A89	2 yrs	$A178
Overseas (air): 1 yr	$A135	2 yrs	$A260

PRICE GUIDE: OTHER PRODUCTS

(all prices include GST on Aust. orders)

***SILICON CHIP BACK ISSUES in stock:** 10% discount for 10 or more issues or photocopies. Australia: $A8.80 ea (including p&p). Overseas: $A10 each (including p&p by air).

***ELECTRONICS AUSTRALIA:** project photocopies, limited back issues. 10% discount for 10 or more issues or photocopies. Australia: $A8.80 each (including p&p). Overseas: $A10 ea (including p&p by air).

***BINDERS:** BUY 5 or more and get them postage free. (Available in Aust. only): $A12.95 each plus $7 p&p per order.

***ELECTRONICS PROJECTS FOR CARS, VOL.2:** Aust. $A14.95; Overseas $A18.00. (Prices include p&p & GST where applicable).

***PERFORMANCE ELECTRONICS FOR CARS:** Aust. $A22.50; Overseas $A26.00. (Prices include p&p & GST where applicable).

SUBSCRIBERS QUALIFY FOR 10% DISCOUNT ON ALL SILICON CHIP PRODUCTS*

* except subscriptions/renewals

Qty	Item Description	Item Price	P&P if extra	Total Price
Total			$A	

RENEW NOW & SAVE A BUNDLE. SUBSCRIPTION PRICE TO RISE SHORTLY.

BUY 10 OR MORE BACK ISSUES & GET A 10% DISCOUNT

Subscribe to SILICON CHIP on-line at: www.siliconchip.com.au
Both printed and on-line versions available

TO PLACE YOUR ORDER

Phone (02) 9939 3295
9am-5pm Mon-Fri
Please have your credit card details ready

OR

Fax this form to (02) 9939 2648
with your credit card details
24 hours 7 days a week

OR

Mail this form, with your cheque/money order, to:
Silicon Chip Publications Pty Ltd,
PO Box 139, Collaroy, NSW,
Australia 2097

35

10-06

1000:1 UHF Prescaler for Frequency Counters

By JIM ROWE

Here's a high speed prescaler which can extend the range of virtually any frequency counter to over 2.8GHz. It divides frequencies by exactly 1000, so gigahertz can be read directly in megahertz.

NOT ALL THAT long ago, almost the only items of domestic equipment operating on a frequency above 1GHz were microwave ovens, all of which use a magnetron operating at 2.45GHz (the frequency which causes maximum heating of water molecules). But nowadays all kinds of equipment transmits and/or receives at frequencies above 1GHz. For example many cordless phones operate at frequencies around 2.4GHz, sharing these frequencies with wireless CCTV cameras, AV transmitters and receivers, security systems, remote access locking systems and baby monitors.

Other items using frequencies in the 2.4GHz region include "WiFi" (802.11b & 802.11g) computer networking gear and "Bluetooth" wireless links for computer peripherals (802.11a wireless networking equipment operates on even higher frequencies, at about 5GHz).

Then there are wireless internet service providers, which mainly use frequencies around 1.9GHz or 2.6GHz and there are "3G" digital mobile phones which operate on frequencies of around 2.1GHz in metropolitan areas. We mustn't forget GPS receivers either. These operate on frequencies of 1.57542GHz and 1.2276GHz.

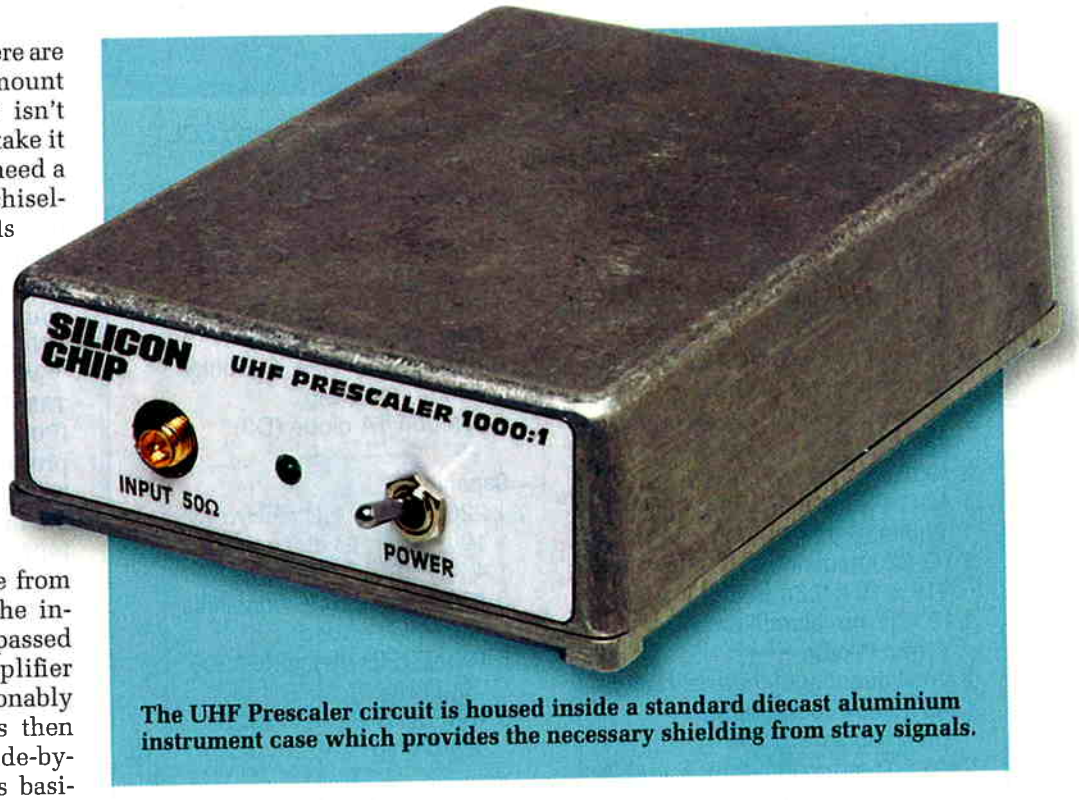
So how can you check the operating frequency of any of these devices, when the range of most reasonably-priced frequency counters only extends up to 1GHz? Well, you can either fork out the dough to buy another counter that *is* capable of measuring up to 3GHz or so, or you can build yourself the UHF Prescaler described here. This simply connects "in front" of your existing counter and divides the frequency of the signals you want to measure by exactly 1000. So 1.5GHz becomes 1.5MHz, 2.45GHz becomes 2.45MHz and so on, allowing you to read the incoming frequency directly and without any mental arithmetic.

The Prescaler uses some special high speed ECL (emitter-coupled logic) ICs to perform the 1000:1 frequency division and these are able to operate at input frequencies up to at least 2.8GHz. And because the output frequency of the Prescaler is still only 2.8MHz for an input of 2.8GHz, this means that it should be suitable for extending the range of just about any counter. In fact, it would be a good companion for the 50MHz Frequency Counter described in the October 2003 issue of SILICON CHIP.

So if you want to be able to measure frequencies up to at least 2.8GHz with your trusty old lower frequency counter, this project is for you. All of the components and circuitry are on a

single PC board and although there are quite a few very small surface mount parts to fit on the board, this isn't unduly difficult providing you take it slowly and carefully. You will need a soldering iron with a very fine chisel-shaped bit, plus steady hands and an illuminated magnifier to help in seeing what you're doing.

We'll also give you a few tips on manual soldering of SMDs (surface mount devices) in the accompanying panel.



The UHF Prescaler circuit is housed inside a standard diecast aluminium instrument case which provides the necessary shielding from stray signals.

Circuit description

In terms of its basic operation the Prescaler is pretty straightforward, as you can see from the block diagram of Fig.1. The incoming UHF signals are first passed through wideband input amplifier IC1, to make the Prescaler reasonably sensitive. The boosted signals then pass through a high-speed divide-by-four stage using IC2, which is basically a pair of very fast ECL flipflops in cascade.

The output of IC2 then passes to IC3, which is another very fast ECL counter programmed to divide by 125. So the output from IC3 is a signal with a frequency 1/500th that of the UHF input signal.

Because the output of IC3 is in the form of very narrow pulses, we then pass them to IC4. This is an ECL JK flipflop, connected here not only to divide the frequency by a further factor of two but also to provide square-wave outputs so they're more suitable for triggering low-frequency counter input circuitry. Then to make the outputs even more compatible with virtually any common frequency counter or scope, we finally pass them through a simple logic level interface stage using transistors Q1 and Q2.

For a more detailed understanding of the Prescaler, let's refer now to the main circuit diagram – see Fig.2.

The UHF signal to be measured enters via CON1 and first passes through an input termination and overload protection circuit formed by two 100Ω resistors and diodes D1 & D2. The two resistors are in parallel to provide an input termination of 50Ω, while D1 & D2 are 1PS70SB82 very low capacitance Schottky barrier diodes, having a very low forward voltage drop. Because they're connected in inverse parallel, they limit the input signal level to no more than 2V peak-peak.

The signal is then coupled to the input of IC1 via a 10nF capacitor. IC1 is a Mini-Circuits ERA-2SM monolithic broadband amplifier device, with about 12dB of gain up to over 5GHz. IC1 is fed with DC power via its output (pin 3), with the 47Ω resistor chosen to set the correct operating current. As the power feed is effectively in parallel with the output of IC1, choke RFC3 is used to provide a reasonable load. This choke is a Mini-Circuits ADCH-80A, a special very wideband device chosen because it has a very low parasitic capacitance and is therefore not self-resonant at frequencies below about 8GHz.

From the output of IC1 the boosted signal is fed to the clock input of IC2 via another 10nF capacitor. By the way, it's the value of the coupling capacitors at the input and output of IC1 which determine the lowest frequency that the Prescaler will work at. The 10nF capacitors as shown allow it to work down to below 50MHz. The reason why we don't use larger values to extend the range even lower down is that larger value capacitors tend to self-resonate at frequencies below 4GHz – which we don't want because it would lower the maximum frequency of operation.

IC2 is our first and most critical frequency divider and it's an MC10EL33 device from On Semiconductor. This is an ECL divide-by-4 device with very impressive specifications. It can operate at input frequencies up to at least 3.8GHz and has a propagation delay of less than 800ps (picoseconds!). It even includes its own bias voltage source (Vbb, pin 4) which is used to provide the correct ECL bias for its two inputs (via the 2.2kΩ resistors).

IC2 has complementary outputs (pins 7 & 6) which both need to be tied

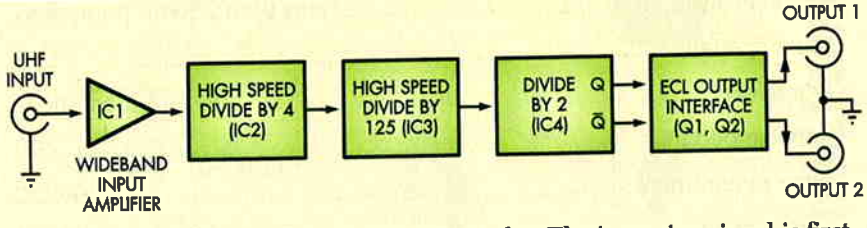


Fig.2: the block diagram for the UHF Prescaler. The incoming signal is first amplified and then divided by 1000 using IC2, IC3 & IC4. It is then fed to two separate output sockets via transistors Q1 & Q2.

Parts List

1 double-sided PC board, code 04110061, 81 x 111mm
1 diecast aluminium box, 119 x 93.5 x 34mm
1 reverse polarity PC-mount SMA socket (CON1)
2 PC-mount BNC sockets (CON2, CON3)
1 PC-mount 2.5mm concentric DC connector (CON4)
1 PC-mount DPDT toggle switch (S1)
2 10µH RF chokes (RFC1, RFC2)
1 ADCH-80A UHF wideband RF choke, SMD (RFC3)
1 TO-220 heatsink, 6073 type (19 x 19 x 9.5mm)
1 12 x 12mm aluminium sheet (1mm thick)
1 small quantity of thermal grease
1 M3 x 6mm round-head machine screw
6 M3 x 15mm countersunk machine screws
6 6mm-long untapped metal spacers
7 M3 nuts & star lockwashers

Semiconductors

1 ERA-2SM UHF monolithic amplifier (IC1)
1 MC10EL33 high speed divide-by-4 ECL divider (IC2)
1 MC10E016 high speed ECL programmable counter (IC3)
1 MC10EL35 high speed ECL JK flipflop (IC4)
1 7805 +5V 3-terminal regulator (REG1)
2 PN200 PNP transistors (Q1,Q2)
1 3.3V 1W zener diode (ZD1)
1 3mm green LED (LED1)
2 1PS70SB82 UHF Schottky diode (D1,D2)
1 1N4004 1A diode (D3)

Capacitors

1 2200µF 16V RB electrolytic
1 10µF 16V RB electrolytic
1 4.7µF 16V tantalum
3 100nF multilayer monolithic ceramic (leaded)
6 100nF X7R dielectric 1206 SMD chip
8 10nF X7R dielectric 1206 SMD chip

Resistors (0.25W 1%)

2 2.2kΩ 0805 SMD chip
1 430Ω
1 330Ω
2 300Ω
1 120Ω
2 100Ω 0805 SMD chip
2 100Ω
1 75Ω
2 56Ω 0805 SMD chip
3 51Ω
1 47Ω 0805 SMD chip

Specifications

This UHF Prescaler is a high-speed frequency divider designed to extend the range of low-frequency counters to at least 2.8GHz. It divides the input frequency by a factor of 1000, so GHz (gigahertz) may be read directly in megahertz. There are two independent outputs, both compatible with the input of virtually any frequency counter or oscilloscope.

Maximum input frequency	2.8GHz minimum
Minimum input frequency	50MHz maximum
Input sensitivity	less than 250mV peak-peak
Input impedance	50Ω
Output level	875mV peak-peak
Output impedance	75Ω
Power requirement	9V DC
Current drain	190mA
Power dissipation	1.7W

to ECL low logic level via termination resistors of close to 50Ω. Here we use 56Ω chip resistors, because this value is more readily available than 51Ω.

From pin 7 of IC2 the signal (now 1/4 the input frequency) passes directly to the clock input of IC3, an MC10E016 ECL 8-bit programmable synchronous binary counter able to count/divide input frequencies up to at least 700MHz.

We have programmed it to divide by 125, by tying its parallel load inputs (P0-P7, pins 3-7 and 21-23) to the appropriate ECL logic levels. For division by 125, we set the parallel inputs to the binary code for 256 - 125, or 131: ie, 10000011. Note that the ECL high or "1" level is established by the 75Ω and 430Ω resistors, forming a voltage divider across the 5V supply rails.

The output signal from IC3 (1/500 of the input frequency) appears at the terminal count or TC-bar pin (19), which again must be tied to the ECL logic low level via a terminating resistor (here 51Ω, because it's a standard leaded part). The ECL logic low level is established by ZD1, a 3.3V zener diode.

By the way if you're wondering where the current for ZD1 comes from, to establish the nominal 3V level, it's sourced from the various ECL outputs tied to it via the termination resistors, plus the inputs of IC3 that are connected directly.

As mentioned earlier, the output signal from IC3 is low in frequency (below 8MHz) but it's in the form of very narrow pulses which would probably pose problems for the input circuitry of many low-frequency counters. That's why we don't program IC3 to divide by 250 (which is easily done).

Instead, we program it to divide by 125 and feed its output to a third ECL device, IC4. This is an MC10EL35, a very fast JK flipflop with its J and K inputs tied to ECL logic high level so it operates in toggle mode as a divide-by-two counter.

So at the complementary outputs (pins 7 and 6) of IC4 we finally get output signals of exactly 1/1000th the input frequency and, just as importantly, in the form of symmetrical square waves which are much more compatible with typical counter input circuits. The outputs of IC4 are again tied to ECL logic low level via 51Ω terminating resistors.

Since the outputs from IC4 are still

switching between ECL levels (nominally +3V and +4V), the remaining step is to pass them through a level translation and output buffer/interface circuit, to provide them as buffered low-impedance signals referenced to ground. This job is performed by transistors Q1 and Q2, connected as a differential switch. This has the advantage that it allows us to easily provide the Prescaler with two independent outputs, so that it can drive either two different counters or perhaps a counter and an oscilloscope.

Because all the Prescaler circuitry operates from a single 5V DC supply, the power supply is very straightforward and involves only a 7805 regulator (REG1), driven from an external 9V DC plugpack. Although the total current drain is about 190mA, giving a regulator dissipation of about 800mW, the regulator is provided with a small heatsink so it keeps reasonably cool.

Construction

As you can see from the photos, all the Prescaler circuitry is on a double-sided PC board measuring 111 x 81mm and coded 04110061. This board has rounded cutouts in each corner so that it fits snugly inside a standard diecast aluminium instrument case, measuring 119 x 93.5 x 34mm. It's actually mounted on the box lid, which forms the Prescaler's base.

All the connectors, power switch S1 and the power indicator LED (LED1) are mounted on the top of the board, along with the regulator (on its heatsink), transistors Q1 and Q2 and the other leaded components. The surface-mount ICs and other components are mounted on the underside of the board.

There are quite a few connections between the two copper layers of the board but these aren't likely to pose a problem even if you don't get a board with plated-though holes. Some of the connections are achieved simply by soldering the leaded component leads on both top and bottom, while the others are mostly "vertical links" between the upper and lower ground-plane copper areas. These links are easy to make using short lengths of tinned copper wire (eg, resistor and diode lead offcuts).

The location and orientation of all the parts on both sides of the board are shown clearly in the two PC board overlay diagrams of Fig.3, so you

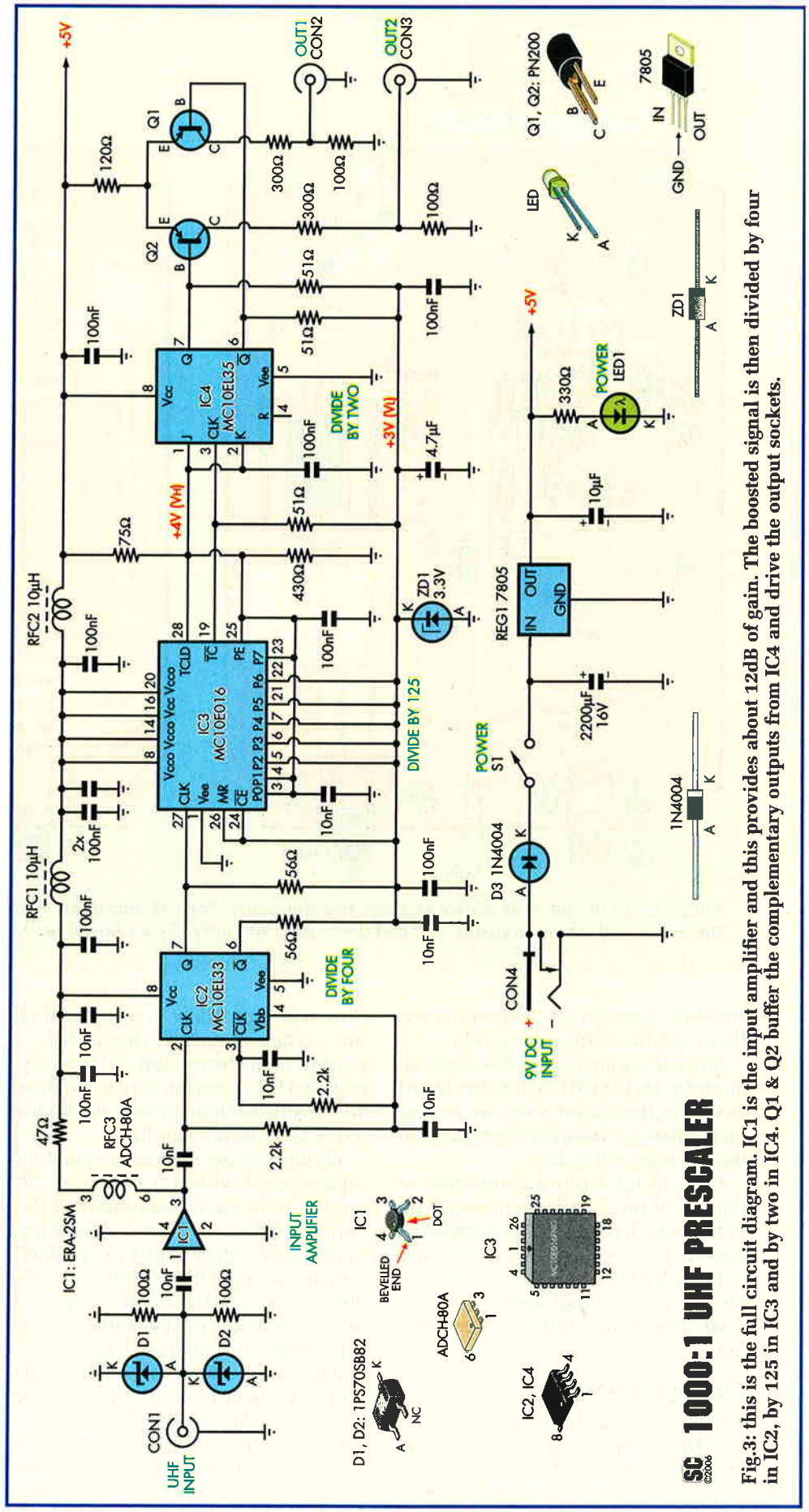


Fig.3: this is the full circuit diagram. IC1 is the input amplifier and this provides about 12dB of gain. The boosted signal is then divided by four in IC2, by 125 in IC3 and by two in IC4. Q1 & Q2 buffer the complementary outputs from IC4 and drive the output sockets.

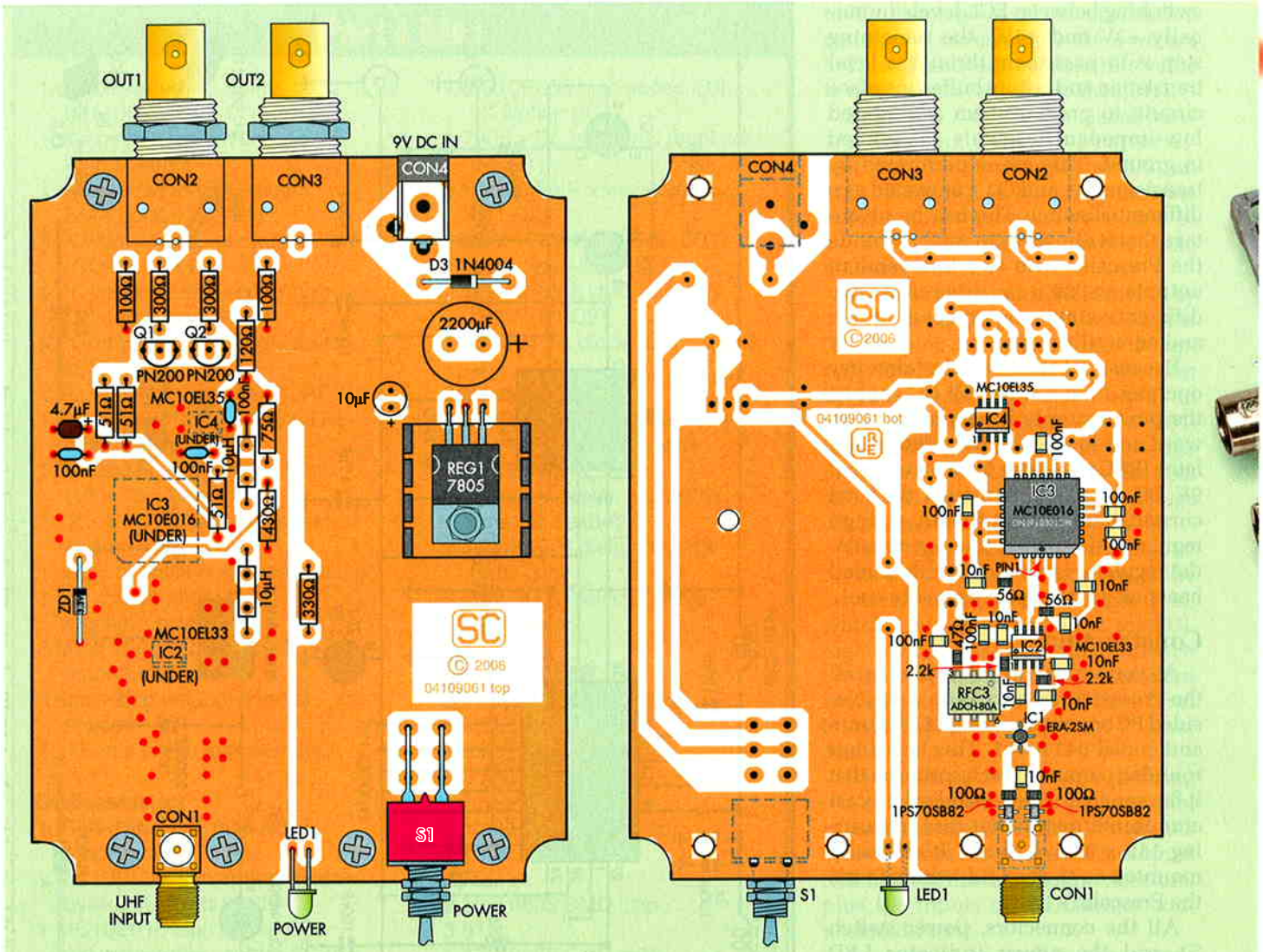


Fig.3: install the parts as shown in these two diagrams. The red dots show where you have to solder to both sides of the board and where to install vertical wire links (but only if your board isn't supplied with plated-through vias).

shouldn't have any problems if you use these and the photos as a guide.

Since there are quite a few surface-mount parts (SMDs) to fit to the board as well as the leaded parts, we recommend that you assemble everything in the order set out below.

First, fit the various connectors to the top of the board, beginning with CON1, which is a reverse polarity SMA socket. Follow this with CON2 and CON3 (the BNC sockets) and finally the DC power input socket (CON4). That done, fit the DPDT power switch (S1).

Fitting the SMDs

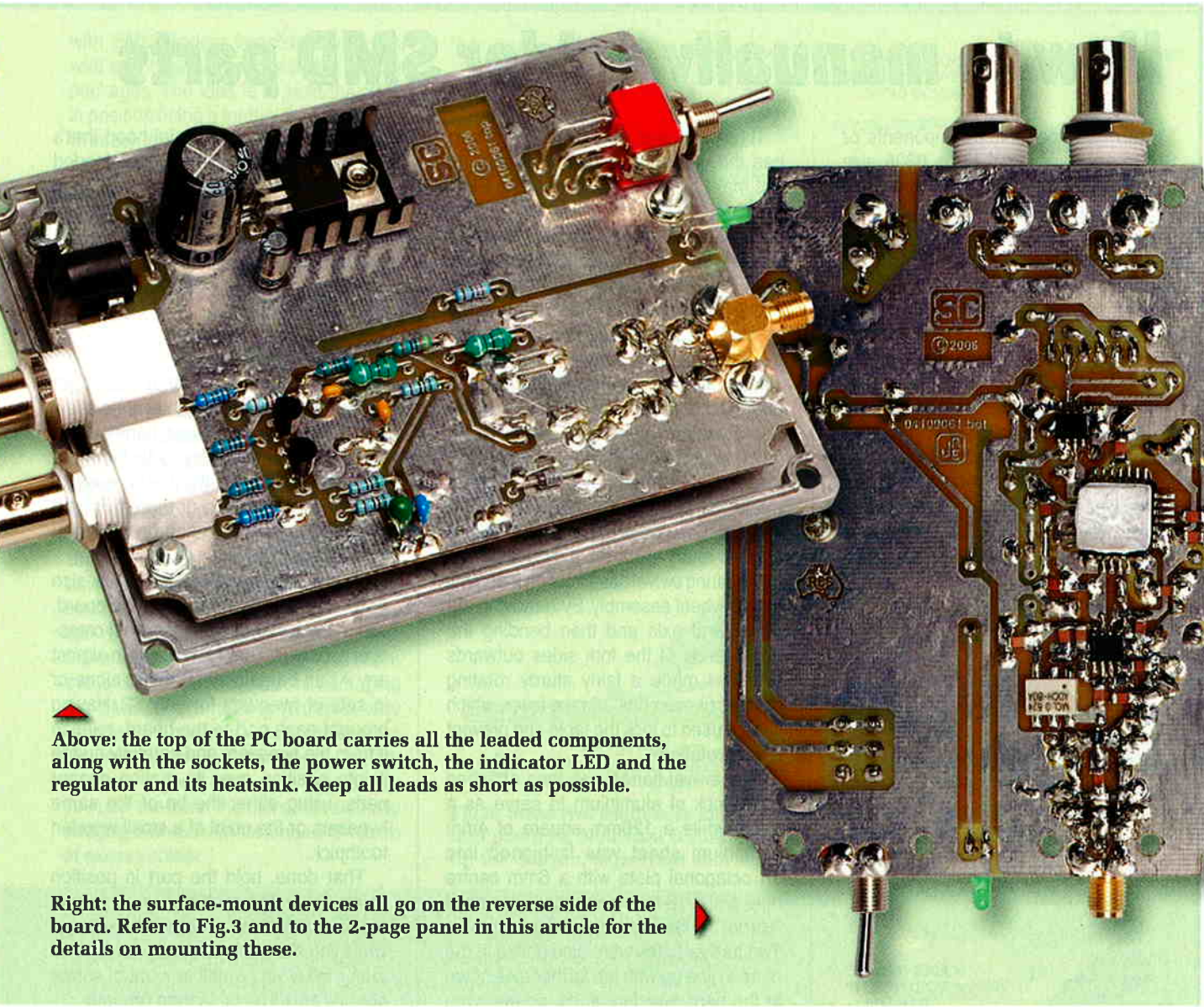
Next, turn the board over and lay it "bottom copper up" on your workbench, using a small block of wood or plastic if necessary to support it. This will then allow you to fit all of the surface-mount devices, with a minimum of obstruction. Fit the chip resistors first, then the chip capacitors and finally the input protection diodes (D1 & D2), the ICs and RFC3.

We have prepared an accompanying 2-page panel with some diagrams to guide you in manual assembly of the various SMD parts. There's also a photo of a small rotary "SMD work table" which you might like to duplicate. We also recommend the use of a magnifier lamp – ie, the type that's fitted to an articulated, spring-loaded arm.

After you've fitted all of the SMD parts, the board can be turned over again and the smaller leaded parts fitted, including the resistors, RFC1 and RFC2 and the small capacitors. As mentioned earlier, some of the leads of these parts are used to make connections between the top and bottom copper – so remember to solder the leads concerned on both sides. They're identified with a red dot on the PC board overlay diagrams of Fig.3.

If your PC board is not provided with plated-through hole vias, there will also be quite a few "vertical links" to fit, to provide low impedance links between the top and bottom copper. These are also identified on the overlay diagrams with a red dot, so don't forget them. They can be made using resistor or diode lead offcuts – just don't overheat or dislodge any of the SMD parts nearby when you're soldering them in place.

Next fit LED1, the Prescaler's power indicator. This mounts in the front centre of the board, with its leads bent



Above: the top of the PC board carries all the leaded components, along with the sockets, the power switch, the indicator LED and the regulator and its heatsink. Keep all leads as short as possible.

Right: the surface-mount devices all go on the reverse side of the board. Refer to Fig.3 and to the 2-page panel in this article for the details on mounting these.

forwards by 90° so that it lines up with CON1 and switch S1. Position it so that it will later protrude through its mating hole in the front panel.

The final parts to fit are power diode D3, the two electrolytic capacitors and regulator REG1. As shown on Fig.3 and in the photos, the regulator mounts flat against a small 6073 type TO-220 heatsink and this assembly is secured to the board using an M3 x 6mm screw and nut. Tighten the screw *before* soldering the regulator's leads, to avoid stressing the solder joints.

Functional checkout

At this stage your Prescaler should

continued on page 44

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	430Ω	yellow orange brown brown	yellow orange black black brown
❑	1	330Ω	orange orange brown brown	orange orange black black brown
❑	2	300Ω	orange black brown brown	orange black black black brown
❑	1	120Ω	brown red brown brown	brown red black black brown
❑	2	100Ω	brown black brown brown	brown black black black brown
❑	1	75Ω	violet green black brown	violet green black gold brown
❑	2	56Ω	green blue black brown	green blue black gold brown
❑	3	51Ω	green brown black brown	green brown black gold brown

How to manually solder SMD parts

Many surface-mount components or SMDs are very small – the 0805 size chip resistors are only 2 x 1.3mm, while 1206 size chip capacitors are only slightly larger at 3 x 1.5mm. Many SMD IC packages have leads spaced only 1.27mm apart. SMDs are not really designed for manual assembly but it's quite feasible to fit many of the more common types by hand if you take care and use the right tools.

For a start, your soldering iron should be fitted with a fine chisel-point tip, which should be well tinned and kept as clean as possible. Ideally it should be of the low-power temperature-regulated type as well. You also need to use fine-gauge resin cored solder, ideally no more than 0.8mm in diameter.

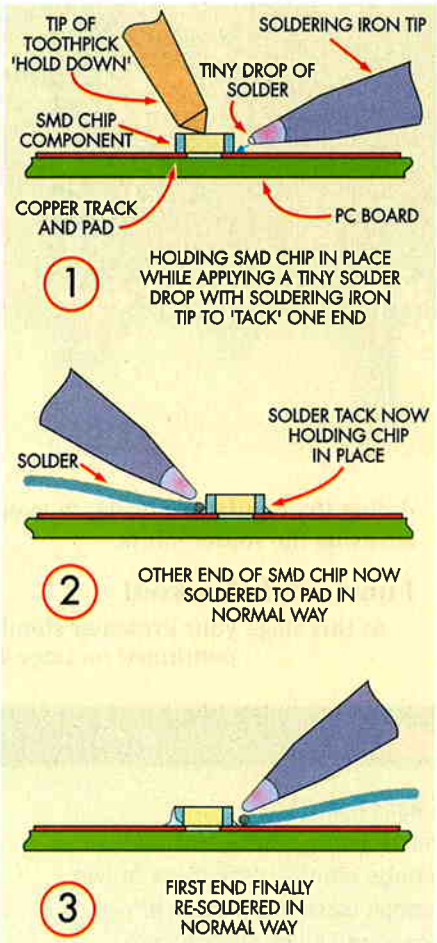

TIP OF TOOTHPICK 'HOLD DOWN'
SOLDERING IRON TIP
TINY DROP OF SOLDER
SMD CHIP COMPONENT
COPPER TRACK AND PAD
PC BOARD
1
HOLDING SMD CHIP IN PLACE WHILE APPLYING A TINY SOLDER DROP WITH SOLDERING IRON TIP TO 'TACK' ONE END
SOLDER
SOLDER TACK NOW HOLDING CHIP IN PLACE
2
OTHER END OF SMD CHIP NOW SOLDERED TO PAD IN NORMAL WAY
3
FIRST END FINALLY RE-SOLDERED IN NORMAL WAY

Fig.7: 0805 and 1206 size SMD chips can be soldered into position with the aid of a toothpick (to hold the device in position) and a soldering iron with a fine tip.

It helps a great deal if your PC board has the copper pads solder-plated, as this makes it much easier to fit the SMD parts.

Manual assembly of SMDs is also a lot easier if the board is held horizontal and level, as they're less likely to move out of position while you're soldering them. In many cases, you can simply place the board flat on your workbench copper side up, although if there are leaded parts already mounted on the other side of the board you may need to support it using small blocks of wood, plastic or metal.

Because it often helps to be able to rotate the board for easier soldering at each end or side of an SMD, I made up a small rotary work table by adapting a ball-bearing swivel base from an industrial castor wheel assembly. By removing the wheel and axle and then bending the upper ends of the fork sides outwards at 90°, I made a fairly sturdy rotating bracket (it even has a brake lever, which can be used to lock the table and prevent it from rotating).

The swivel flange was then attached to a block of aluminium to serve as a base, while a 120mm square of 4mm aluminium sheet was fashioned into an octagonal plate with a 6mm centre hole and 3/16-inch holes tapped in each "corner" for fastening board clamp screws. Two further holes were also drilled in the plate to line up with the former axle holes in the bent-over fork ends, so the plate could be bolted to the top of the fork to form the actual operating table, with its centre hole directly over the centre axis of the base swivel.

You can see the basic construction in the photos, which also show three of the support blocks and clamp brackets I fashioned to hold boards in place. Also visible is a pair of modified crossover tweezers mounted on a pivoting arm arrangement, which can be used to hold some SMDs in place while they are soldered – a kind of "third hand".

Such a work table is not necessary for all SMD work but it might be worth considering if you're likely to be building up quite a few projects.

Another useful accessory for manual SMD work is an illuminated magnifier – a magnifying glass about 120mm in diameter surrounded by a circular fluorescent lamp in a metal hood that's mounted on an articulated, spring-loaded arm attached to a swivel base (so you can position it easily just above the operating table). They're not cheap but if you're likely to be doing a fair bit of manual SMD or just fine PC board assembly, they are a good investment.

One at a time

Before we go any further, here's an important tip: when you have quite a few SMDs to solder to a board, handle them one at a time. If you try to tackle more than one at a time, it's all too easy to accidentally send one or more flying off while you're concentrating on soldering the first one in position.

To handle tiny 0805 and 1206 size SMD chips and bring them to the board, use a small pair of stainless steel crossover tweezers. They're available in almost any Asian bargain store, either alone or in sets of tweezers for only $2. Having brought each part to the board, release it from the tweezers and carefully nudge it into position over its mating copper pads, using either the tip of the same tweezers or the point of a small wooden toothpick.

That done, hold the part in position using either the toothpick or a pair of modified crossover tweezers as a clamp, while you clean the soldering iron tip and then melt a very small amount of solder onto its end. The tip is then brought up to one end of the SMD, at a fairly low angle so the tiny drop of solder comes into contact with both the board copper and the end of the SMD (see Fig.7). The iron tip is only in contact for about half a second – just long enough to allow the drop of solder to tack-bond the two together and hold the SMD in place.

The toothpick or tweezers can now be removed and you can solder the other end of the SMD in the more "normal" fashion before returning to the first end and quickly re-soldering it properly as well. The sequence is shown in Fig.7.

The same basic approach can be used

with SMD diodes, transistors and ICs, with slight variations to suit the various packages. The idea is to hold the SMD in position using a toothpick or crossover tweezer clamp while you tack-solder one of its leads to hold it in place. That done, you can remove the clamp and solder all of the remaining leads properly – and finally, the first lead again. Doing this is much the same whether the SMD has flat horizontal leads emerging from underneath, S-shaped leads that bend outwards at the bottom or J-shaped leads that bend inwards and underneath. Fig.8 shows the idea.

About the only kind of SMD package you can't solder in this way is the type with no leads at all – just "solder bumps" underneath. These really aren't suitable for manual soldering.

One last tip: whether you're soldering SMD chip resistors, capacitors or other devices like diodes, transistors and ICs, make all joints as quickly as you possibly can while at the same time taking care to make a good joint. The faster you make the joint, the lower the risk of damaging the SMD by overheating (which is very easy to do, since they're so tiny). Also use the smallest amount of solder necessary to make a good joint – the less solder you use, the lower the risk of accidentally bridging between device leads with a blob of excess solder.

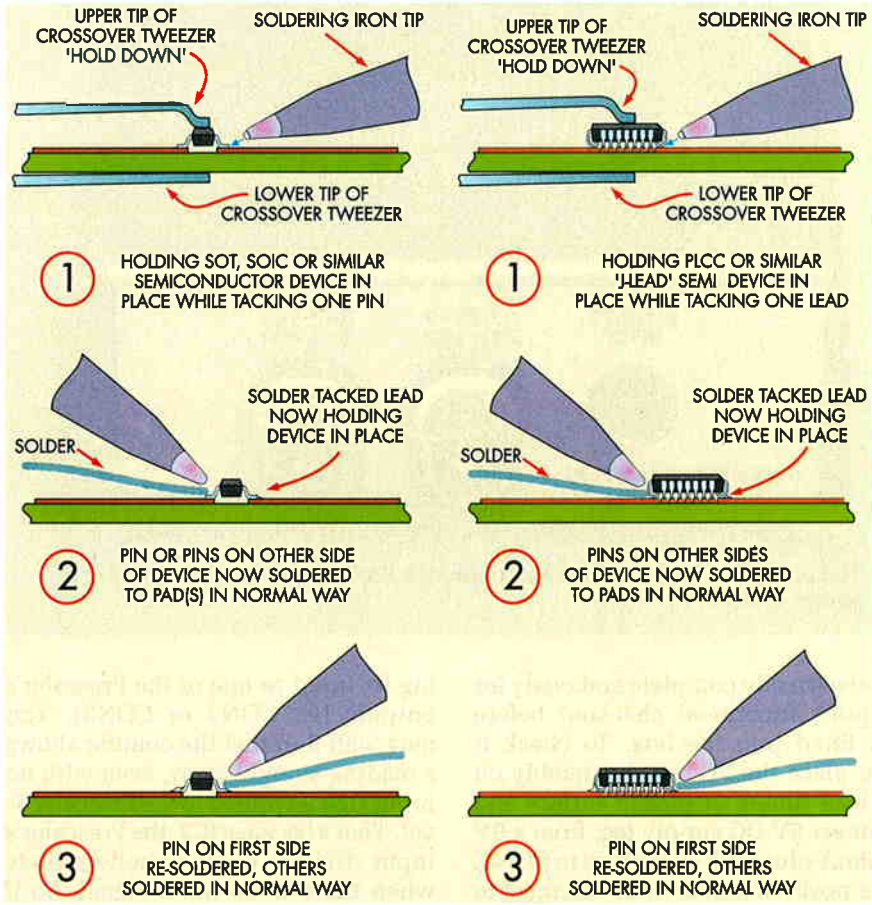
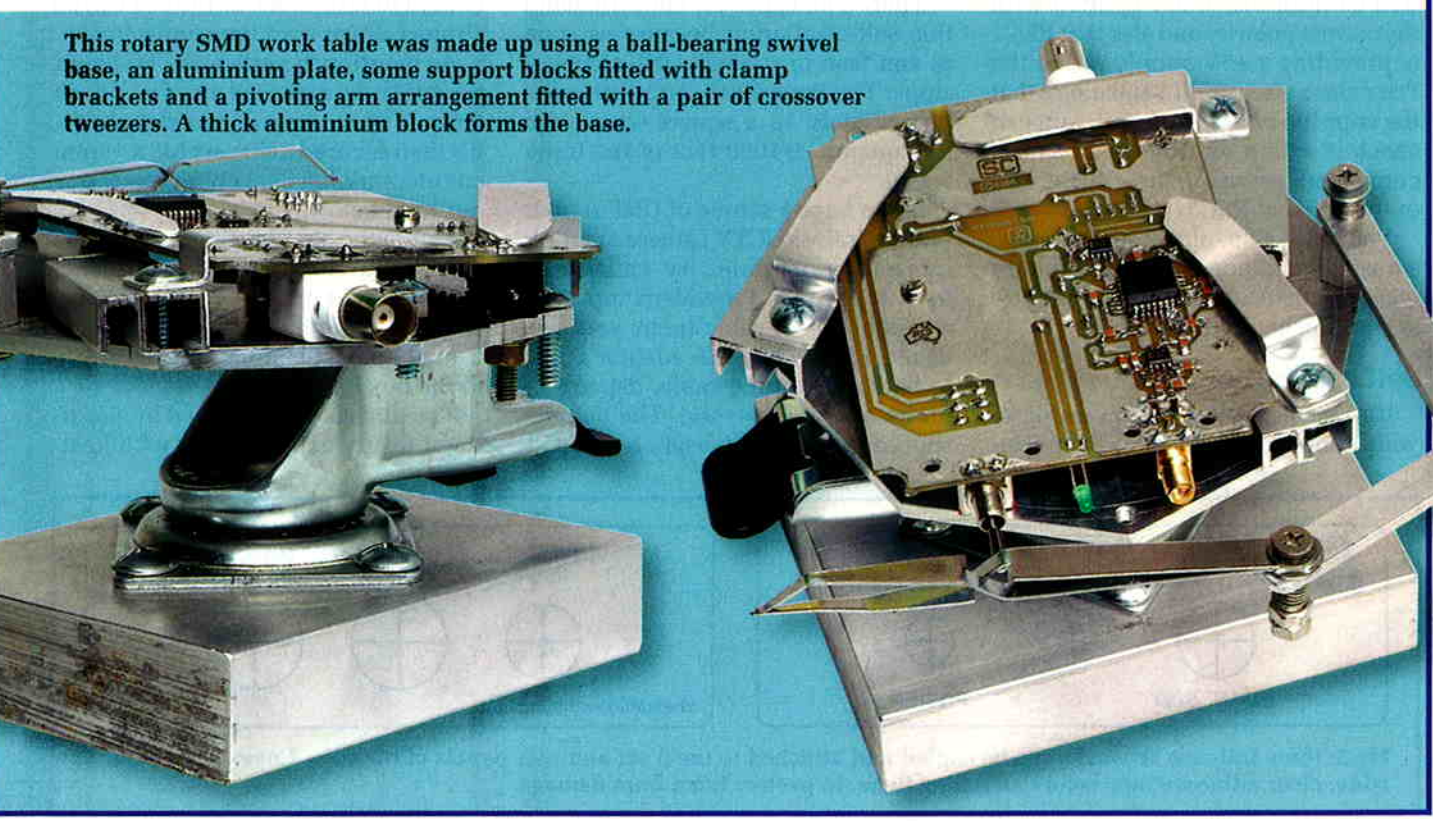

UPPER TIP OF CROSSOVER TWEEZER 'HOLD DOWN'
SOLDERING IRON TIP
LOWER TIP OF CROSSOVER TWEEZER
1
HOLDING SOT, SOIC OR SIMILAR SEMICONDUCTOR DEVICE IN PLACE WHILE TACKING ONE PIN
UPPER TIP OF CROSSOVER TWEEZER 'HOLD DOWN'
SOLDERING IRON TIP
LOWER TIP OF CROSSOVER TWEEZER
1
HOLDING PLCC OR SIMILAR 'J-LEAD' SEMI DEVICE IN PLACE WHILE TACKING ONE LEAD
SOLDER
SOLDER TACKED LEAD NOW HOLDING DEVICE IN PLACE
2
PIN OR PINS ON OTHER SIDE OF DEVICE NOW SOLDERED TO PAD(S) IN NORMAL WAY
SOLDER
SOLDER TACKED LEAD NOW HOLDING DEVICE IN PLACE
2
PINS ON OTHER SIDES OF DEVICE NOW SOLDERED TO PADS IN NORMAL WAY
3
PIN ON FIRST SIDE RE-SOLDERED, OTHERS SOLDERED IN NORMAL WAY
3
PIN ON FIRST SIDE RE-SOLDERED, OTHERS SOLDERED IN NORMAL WAY

Fig.8: these two sequences show how to solder SOT, SOIC and PLCC devices into position. Note that it's important to use a soldering iron with a very fine tip for this job, to prevent shorts between pins.



This rotary SMD work table was made up using a ball-bearing swivel base, an aluminium plate, some support blocks fitted with clamp brackets and a pivoting arm arrangement fitted with a pair of crossover tweezers. A thick aluminium block forms the base.

The rear panel provides access to the two BNC output sockets and the DC power socket.

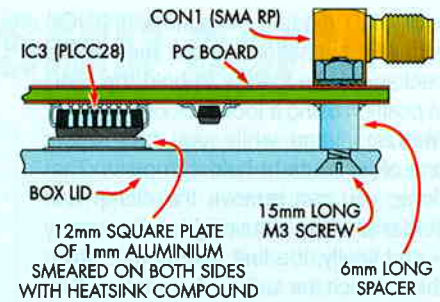


Fig.4: the mounting details for the PC board. Note the aluminium heatsink under IC3.

be electrically complete and ready for a quick functional checkout before it's fitted into the box. To check it out, place the PC board assembly on a clean timber or plastic surface and connect 9V DC supply (eg, from a 9V 250mA plugpack or similar) to CON4. The positive input should connect to the centre pin of CON4.

Now turn on power switch S1 and you should see LED1 light up. This will confirm that LED1 is fitted with the correct polarity and also that REG1 is providing a +5V supply rail to the Prescaler's circuitry. To make sure that the supply voltage is correct, you can check it with a multimeter or DMM, connected between the centre and output pins of REG1.

You can also check the voltage across zener diode ZD1 which should measure about 3.1V if the ECL circuitry is working correctly.

Self oscillation

If all seems well so far, try turning on your frequency counter and connecting its input to one of the Prescaler's outputs (ie, CON2 or CON3). You may well find that the counter shows a reading straight away, even with no input signal applied to the Prescaler as yet. That's because IC2, the Prescaler's input divider, tends to self-oscillate when there is no input signal. So if you connect the second Prescaler output to a scope, you'll probably see a squarewave of about 1.6MHz.

There's no cause for concern about this self-oscillation because as soon as you feed in a "real" UHF signal, it stops. The Prescaler's output changes immediately to a square-wave with a frequency 1/1000 that of the input signal.

If you have a source of UHF signals like a wireless CCTV camera or an AV transmitter module, try connecting its output to the Prescaler's input via a suitable SMA cable (note: you may need an SMA/RP SMA adaptor at one or both ends of the cable, depending on its own connectors). The counter should immediately begin reading its carrier frequency or strictly, 1/1000 of its frequency. So if the camera or AV transmitter module is operating at say 2.432GHz, the counter will read 2.432MHz.

Final assembly

If your Prescaler passes this quick checkout with no evident problems, you'll now be ready to assemble it in the box. This assumes that your box and its lid have been prepared, with of the holes shown in the diagram of Fig.6 having been drilled. If the box hasn't been drilled yet, then now is the time to do so.

Note that the holes for the BNC connectors in the rear of the box are extended to form slots, so the box can be slipped down over the connectors.

As mentioned earlier, the PC board assembly is mounted on the lid on 6mm-long untapped metal spacers. It's then secured using six M3 x 15mm countersink-head machine screws, as outlined below.

Before the board is fitted, attach the small aluminium heatsink plate to IC3, the PLCC28 device. This IC gets fairly warm in operation and the plate helps keep it cool by conducting heat away to the box lid.

The plate is first prepared by smearing it thinly on both sides with heat-

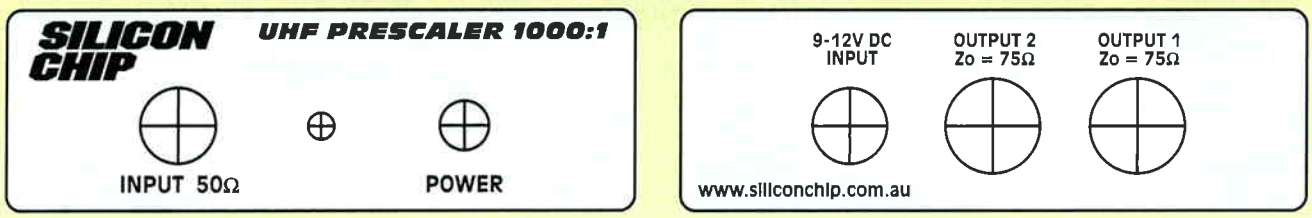


Fig.5: these full-size artworks can be copied and attached to the front and rear panels of the case. Cover them with wide, clear adhesive tape before attaching them, to protect them from damage.

sink compound. That done, press one side to the top of IC3's body, sliding it around a bit so any air bubbles are worked out. Then position it squarely over the IC body, where it will tend to stay put until you fit the board assembly to the box lid.

Attaching the board assembly to the lid is straightforward if you first fit the six countersink head screws through the lid holes and then turn the lid over and place it on the workbench. You then fit one of the 6mm spacers on each screw before lowering the inverted PC board assembly into position. Be sure to press the board down gently just over the position for IC3 (see Fig.3), so that the heatsink compound on the lower surface of IC3's heatsink plate is partly transferred to the box lid underneath, to form a good thermal bond – see Fig.4.

After this, you can fit an M3 star lockwasher on the top of each board mounting screw, followed by an M3 nut. **It's then just a matter of carefully tightening each mounting screw and nut to secure the board and sandwich the aluminium heatsink in position.**

The final assembly step is to fit the box over this assembly. To do this, first remove the nuts and lockwashers from BNC connectors CON2 and CON3 and also remove one nut, the keyed flat washer and the lockwasher from power switch S1. Thread the remaining nut right down to the switch body and then refit the keyed flat washer with its locating lug facing towards the switch body. This washer should also be down against the nut.

Now you should be able to bring the inverted box down over the PC board/lid assembly, at an angle so CON1, LED1 and switch S1 can be mated with the matching holes in the front end of the box. The box can then be lowered at the rear end and moved back at the same time, until the slots in its rear slip down around the threaded ferrules of CON2 and CON3. The box/cover will then be fully mated with the lid, allowing you to invert the complete "shebang" and fit the four box assembly screws.

After this, all that remains is to fit the front and back panel dress stickers to the box (see Fig.5) and finally, refit the remaining nut to power switch S1 and the nuts to CON2 and CON3 at the back. Your UHF Prescaler should now be finished and ready for use.

One final tip: when you're screwing SMA cable connectors and adaptors to the Prescaler's own input connector, be careful. These connectors are designed for precise mating, so they can operate reliably, with low losses up to about 8GHz. As a result they're small and have a fine thread, making them easily damaged by rough treatment. **SC**

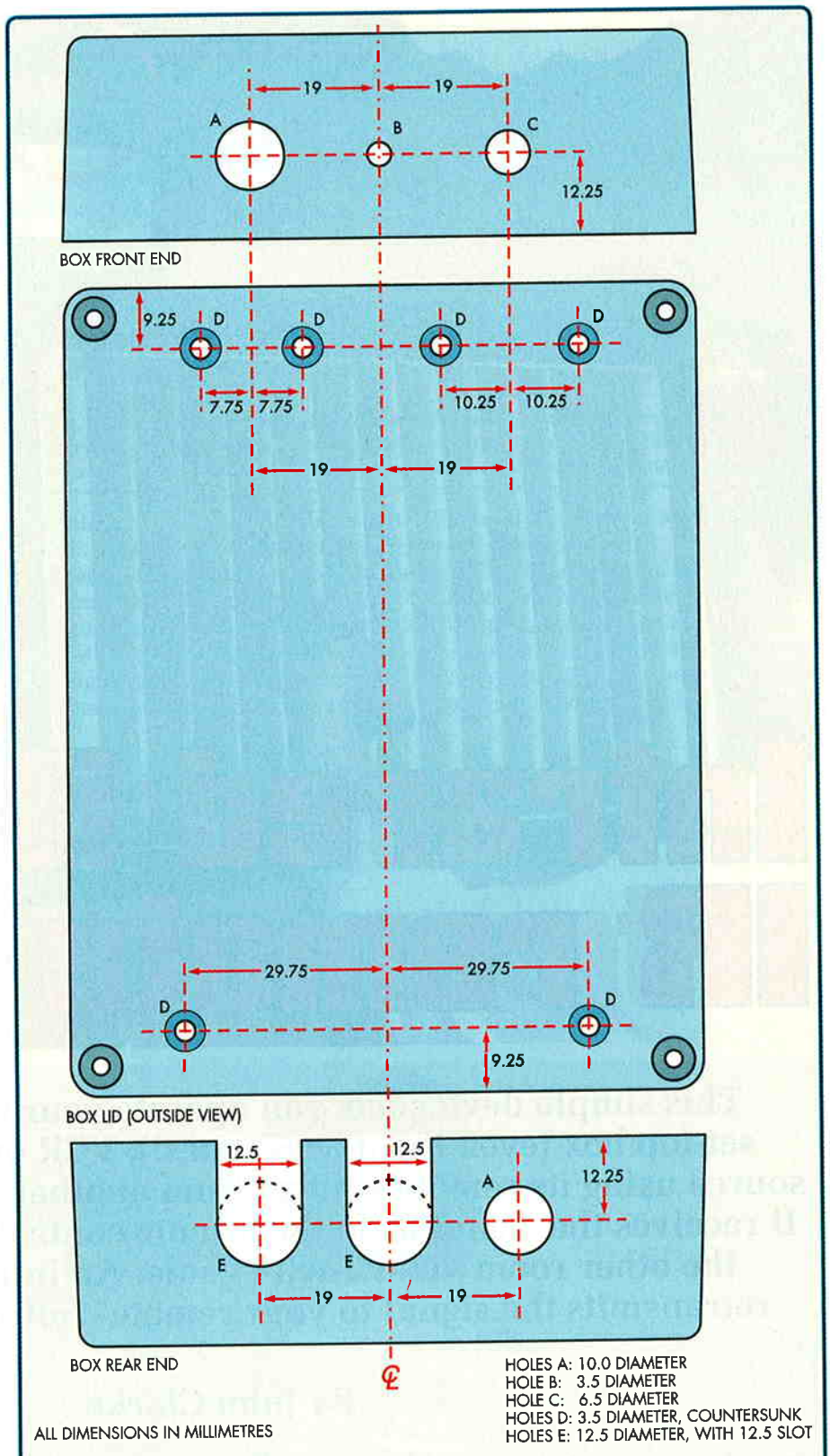
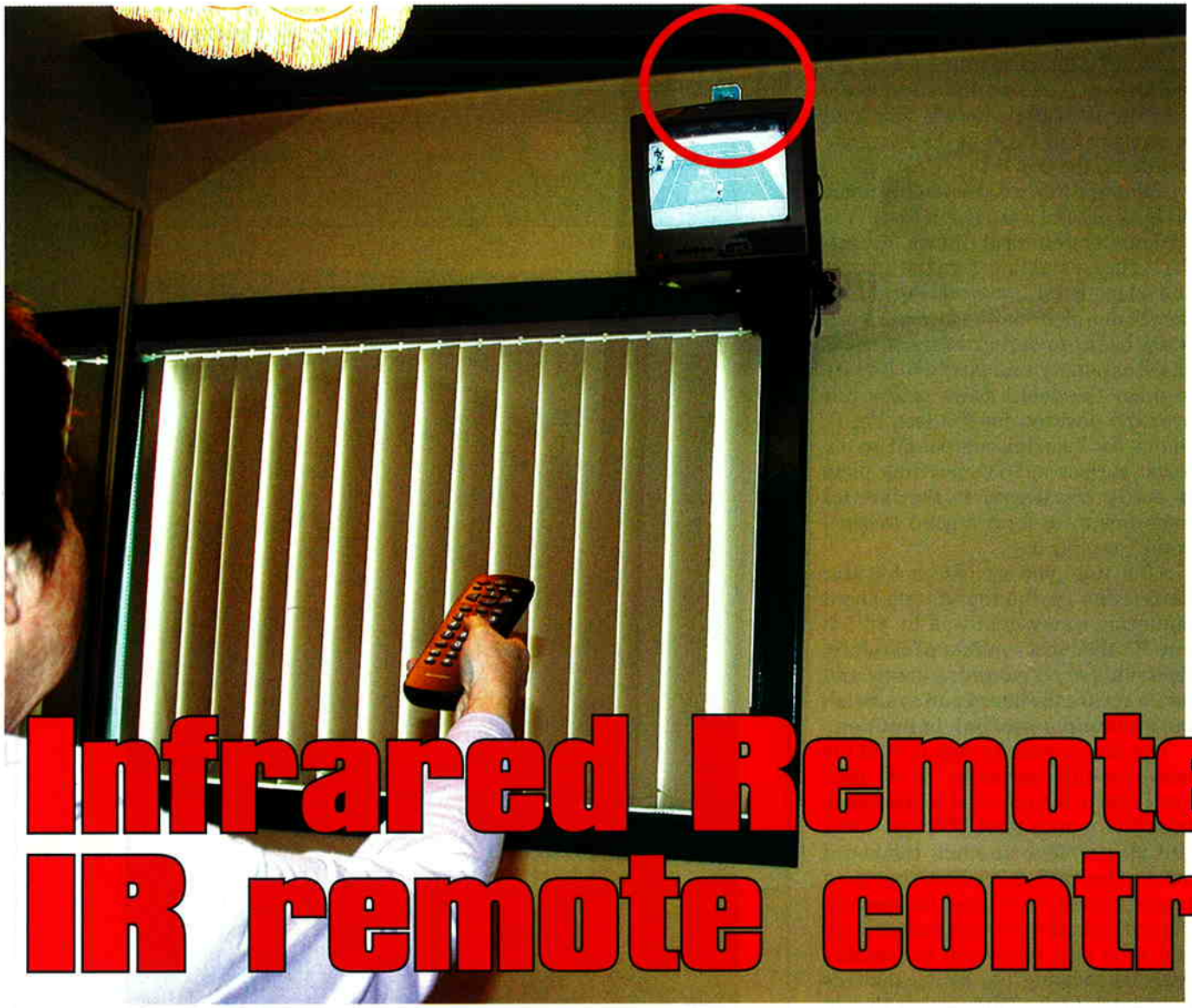


Fig.6: the drilling details for the metal case. Drill pilot holes for the larger holes first, then carefully enlarge them to size using a tapered reamer.



Infrared Remote
IR remote contr

This simple device lets you operate your CD/DVD player, set-top box (even the newest ones!), VCR or other program source using its remote control from another room in the house. It receives the signal from the remote control and relays this to the other room via a 2-wire cable. An infrared LED then retransmits the signal to your remote controlled equipment.

By John Clarke

Yes! This one does work with the new Foxtel Digital set top boxes!

Extender for olled equipment

Modern consumer entertainment equipment invariably includes an infrared remote control. In fact, the equipment is often almost totally reliant on its operation via the infrared remote control, leaving itself relatively free of switches and controls.

Operation via the remote controls is quite handy if you are in the same room as the equipment, however many homes now have a second TV set or set of loudspeakers that are located in another room. These are usually linked to the main equipment using wiring or via a wireless transmitter/receiver.

So how do you control the equipment from another room? The answer is to use a remote control extender as described here.

In use, the Infrared Remote Extender sits somewhere visible (eg, near a TV set or amplifier) and receives signals from the remote control. The arrangement is shown in Fig.1. The Infrared Remote Extender converts these signals into electrical impulses and feeds them down a shielded cable. The end of this cable attaches to an infrared LED placed near the equipment in the other room. The Infrared Remote Extender duplicates the infrared signal produced by the handheld remote control so that the equipment is controlled exactly as if you were in the same room.

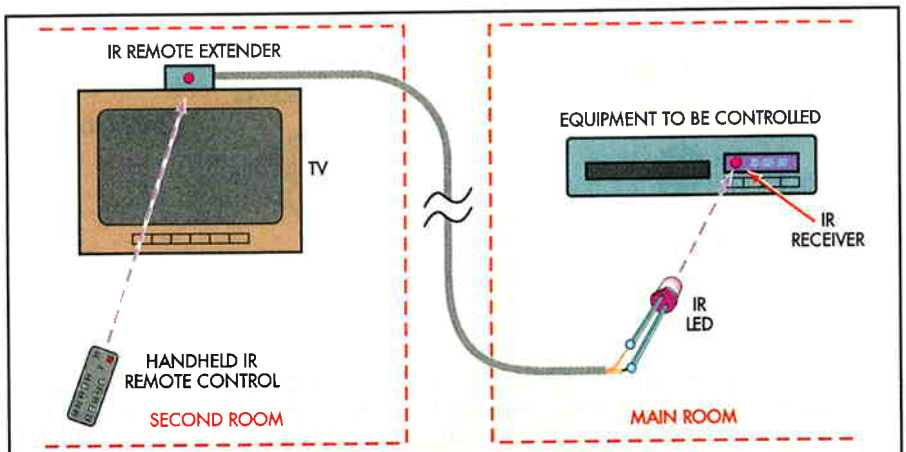


Fig. 1: it's a simple concept – instead of directly controlling equipment the infrared signal is detected and sent by wire to an infrared LED which then mimics the detected signal, beaming it into the remote equipment

The idea of infrared extenders is not new – we have published several in the past, our last one in July 1996.

As can be expected there have been many changes in audio and video equipment since then. Not surprising-

Here's the complete project: the long grey cable runs back to the room where the device to be controlled is situated. The controller is aimed at the blue box, while the infrared LED on the end of the cable mimics the handheld controller signal and thus switches the device in the other room.

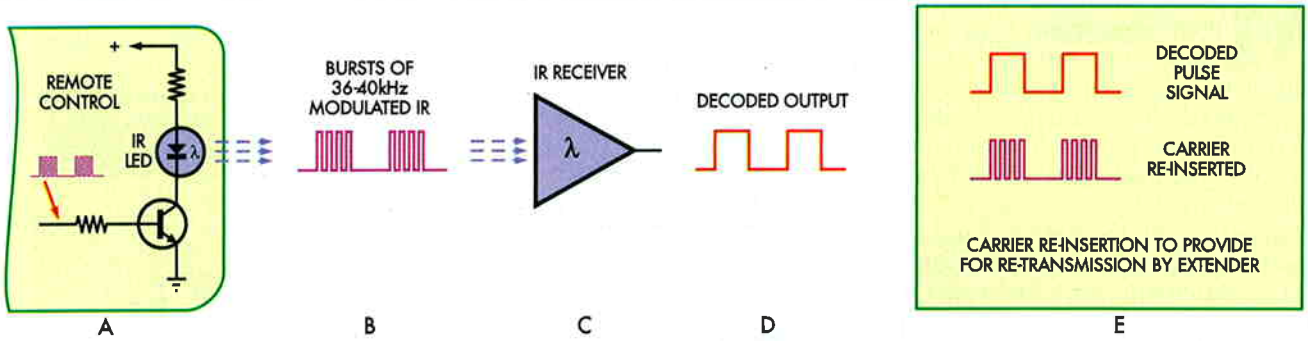


Fig.2: this diagram helps explain how the infrared Remote Control Extender works, as detailed in the text. Basically, when a button is pressed in the remote control (A), a unique (to that button) modulated pulse train is generated and is transmitted as invisible pulses of infrared light (B), which is received and decoded into a pulse train by the IR receiver (C/D). The carrier is reinserted (E) and is sent off to the remote infrared LED, which mimics the signal at A into the device to be controlled.

ly, some of the latest remote controls will not work with the 1996 infrared extender. The reason they do not work is because these later designs transmit data at a much faster rate than older remote controls.

This increase in data rate has come about because equipment now has a huge number of functions, so a lot more data has to be sent by the remote control. The Foxtel digital receiver using the Pace 400 series decoders is one example of a system that transmits at the faster data rate.

Fig.2 shows the way an infrared remote control sends its signals to the equipment under its control. The infrared LED is driven as in circuit (A) and this sends bursts of signal that is typically transmitted at 36kHz although some remote controls transmit bursts at 38kHz or 40kHz. The signal burst is called the carrier and the sequence of bursts (or code) determines the function that the infrared remote control is sending to the receiver. This is shown in (B). So one set of bursts might change the volume while another set of bursts may alter the channel.

The infrared receiver (C) picks up these infrared signals and decodes them (D). A burst of signal from the transmitter is decoded as a low going level while the absence of any signal will be decoded as a high level. If we use the same type of receiver (C) in our Infrared Remote Extender we can reintroduce the carrier frequency and retransmit the infrared signal using the drive circuit shown in (A).

Infrared remote controls send this data according to a standard such as the Philips RC5 code. The RC5 code sends data with a 36kHz carrier and

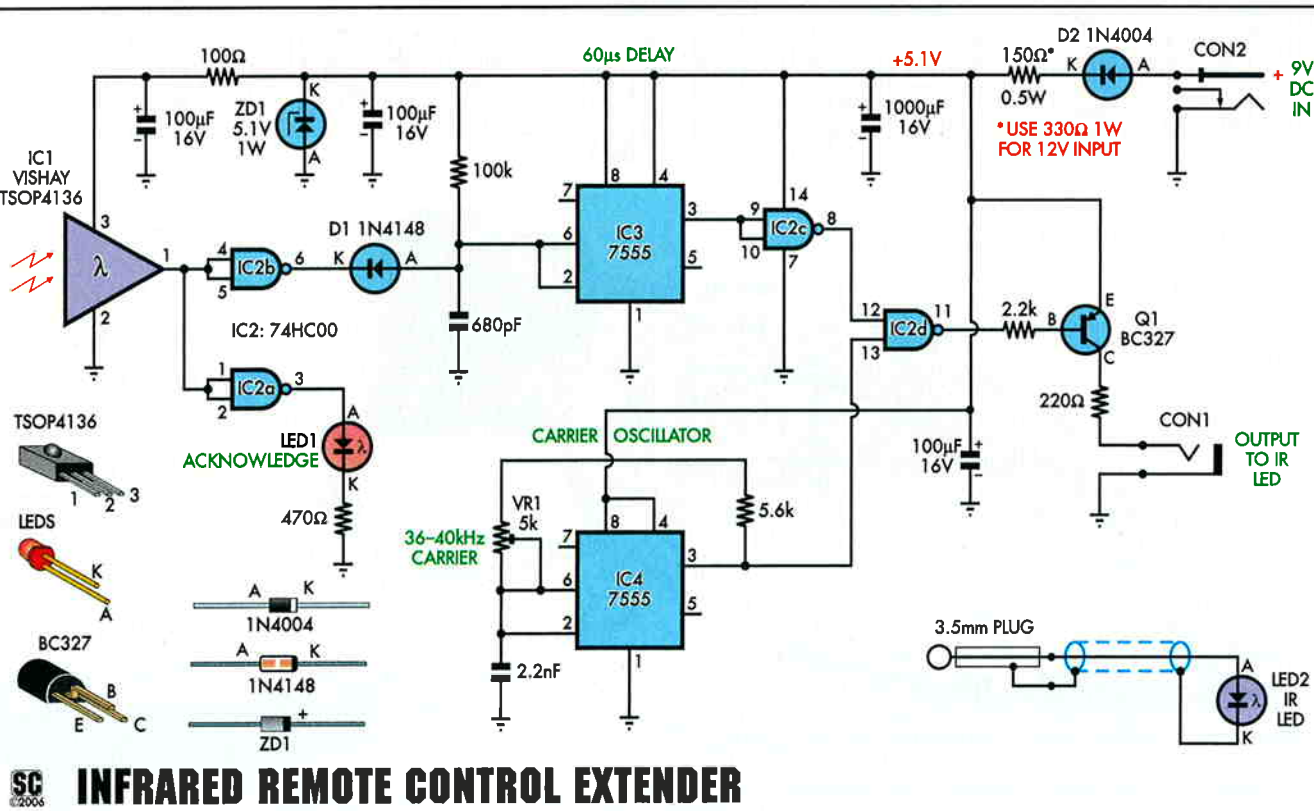


Fig.3: the circuit is based on the infrared receiver/decoder (IC1), some gates and two low-cost timer ICs.

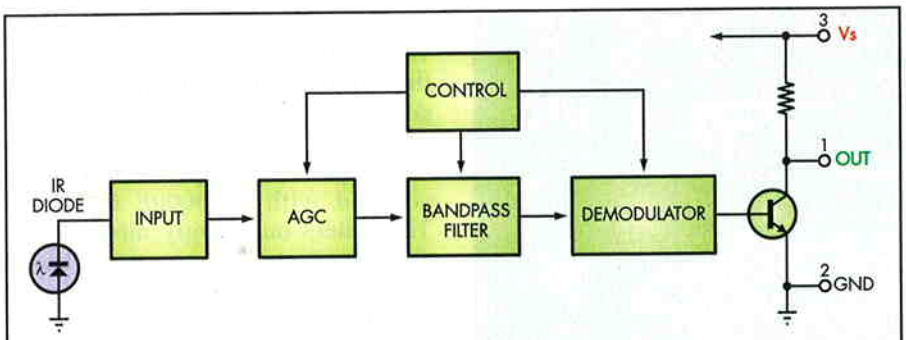


Fig 4: inside the TSOP4136 Infrared Receiver IC. Its job is to detect the modulated pulse train from the handheld infrared remote control, reject any other noise and then present a decoded signal at its output.

the signal bursts are 889µs long. There are other standards such as those by Sony and Sharp where the carrier is 40kHz and 38kHz respectively. A later standard and one used by the Foxtel digital receiver is the RC6 standard. This transmits bursts of the 36kHz signal in shorter bursts 444µs long.

Our latest Infrared Remote Extender uses a Vishay TSOP4136 receiver that can decode all the current data rates used by infrared remote controls. Its block diagram is shown in Fig.4.

The TSOP4136 comes in a small 3-lead package with an integral plastic lens on one side. The lens focuses the infrared light onto an internal receiver diode. The signal from this diode is amplified and filtered to remove signals outside the 36kHz, 38kHz and 40kHz carrier frequencies.

The filtering also removes interference from sources such as fluorescent lights when driven directly from the 240VAC mains or from compact fluorescent lights which operate above 100kHz.

AGC (automatic gain control) is applied so that the demodulator receives adequate signal without overload. The demodulator converts the carrier modulation into an output signal that is then available at the output terminal. The presence of carrier signal sets pin 1 at ground potential. Otherwise the output is at V_s potential when there is no carrier signal detected.

The circuit

Fig.3 shows our new Infrared Remote Extender circuit. The demodulated output from IC1 is fed to NAND gates IC2a & IC2b. IC2a drives the acknowledge LED (LED1) via a 470Ω resistor which should flash in response to the signal transmitted by your remote control. IC2b's output is fed via diode D1 to pins 2 & 6 of IC3, a 7555 CMOS timer which is used here as a high speed comparator.

This part of the circuit is there to correct a quirk of IC1, in that its output responds faster to the presence of IR signal (when its output goes low) than when signal ceases and the output goes high again.

The difference is only around 60µs but it is critical in ensuring that the infrared remote control extender reproduces the original transmission as closely as possible.

Normally in the absence of infrared signal, the output of IC1 is high and so the output of IC2b is low and diode D1 therefore holds the 680pF capacitor discharged. Pins 2 & 6 of IC3 are there-

$10000 PRIZE POOL!

2006 SILICON CHIP
Excellence in Education Technology Awards
Closing in a few days!

SILICON CHIP'S Excellence in Education Technology awards carry a prize pool of $10,000. Separate awards will be made to students of secondary schools throughout Australia and to students of universities and TAFE colleges throughout Australia.

The secondary school awards have three categories:

(a) Best final year assignment of an individual student involving electronics technology.
(b) An award to the school sponsoring the winning individual student.
(c) Best school project involving electronics technology.

The university and TAFE college awards have three categories:

(a) Best project from a student as part completion of a degree, diploma or certificate in electronics or a related field (ie, mechatronics).
(b) Best research project from a post-graduate student working in an area of applied electronics.
(c) An award to the university faculty or school sponsoring the best research project.

Entries and judging

The awards will be judged by the editorial staff of SILICON CHIP, convened as a judges panel. The decisions of the judges will be final. Entry requirements are as follows:
(1) A description of the project in no more than 1000 words.
(2) Full circuit and wiring diagrams, performance plots, etc.
(3) Good quality photographs to show all visual aspects of the project.
(4) Details of software.

Entries for the 2006 awards close on October 16th, 2006. All submissions will be confidential, until the winners are announced, in the December 2006 issue of SILICON CHIP.

Each award will take the form of a cash prize and a commemorative plaque. All enquiries about these awards should be directed to the editor via email to: awards@siliconchip.com.au

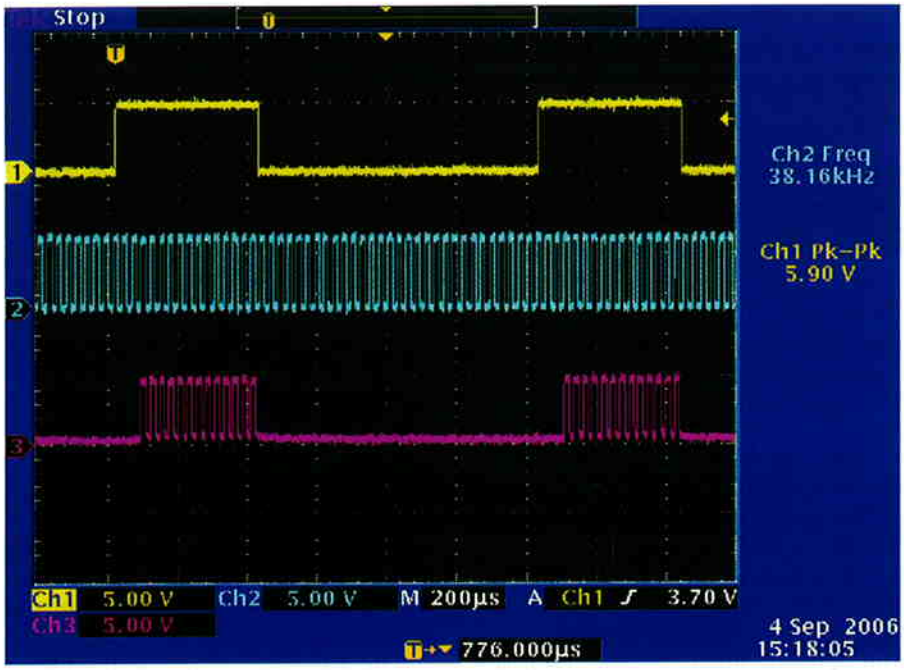


Fig.5: this scope grab demonstrates the operation of the Remote Control Extender. The top trace (yellow) is the detected signal at pin 3 of IC2a which drives the acknowledge LED. The centre trace (blue) is the 38kHz carrier signal from pin 3 of IC4. The bottom trace (magenta) is the gated 38kHz carrier at the collector of transistor Q1.

fore low and pin 3 of IC3 is high.

When IC1 receives an infrared signal, pin 6 of IC2b goes high, diode D1 is reverse biased and so the 680pF capacitor begins to charge towards the 5.1V supply via the 100kΩ pull-up resistor. After 60µs the voltage reaches 2/3 the supply and pin 3 of IC3 goes low. So this adds a delay of 60µs.

When IC1 ceases receiving an infrared signal from the remote control, its pin 1 goes high, taking pin 6 of IC2b low. The 680pF capacitor is quickly discharged via diode D1, allowing pin 3 of IC3 to go high almost instantly. Thus we have a delay for negative-going signals from IC1 but negligible delay for positive going signals (this is because IC2b inverts).

Reinsertion of carrier

IC4 generates the carrier signal that was originally present in the IR signal from the remote control. It is another 7555 CMOS timer but this time connected to oscillate at between 36kHz and 40kHz, depending on the setting of trimpot VR1.

Its operation is as follows: the 2.2nF capacitor charges up via VR1 and the series connected 5.6kΩ resistor when the pin 3 output of IC4 is high. When the capacitor voltage reaches 2/3 the supply voltage, the pin 3 output goes low and the capacitor is discharged by the same resistors connected to pin 3. When the capacitor voltage falls to 1/3 the supply voltage, the pin 3 output goes high and charges the capacitor again.

The positive supply to IC4 is decoupled with a 1000µF capacitor. This filters out supply modulations at the oscillator frequency that could otherwise be detected by IC1 via the supply rail.

The output from IC3 is inverted with NAND gate IC2c and applied to pin 12 of NAND gate IC2d. The carrier frequency is fed to pin 13 of IC2c. Thus IC2c gates the carrier on and off in response to the detected signal from IC1 and this will reconstitute the original IR signal from the remote control.

IC2d drives transistor Q1 and in turn this drives the infrared LED (LED2) via a 220Ω resistor.

Construction

The Infrared Remote Extender is built onto a PC board coded 02110061 and measuring 79 x 47mm. It is housed

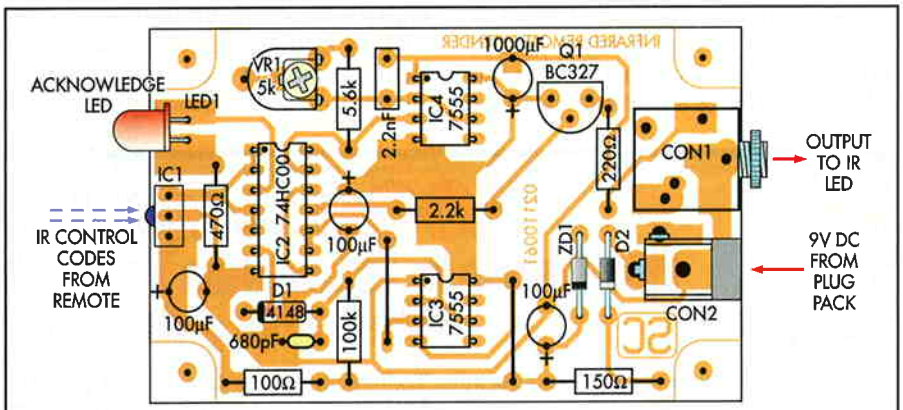
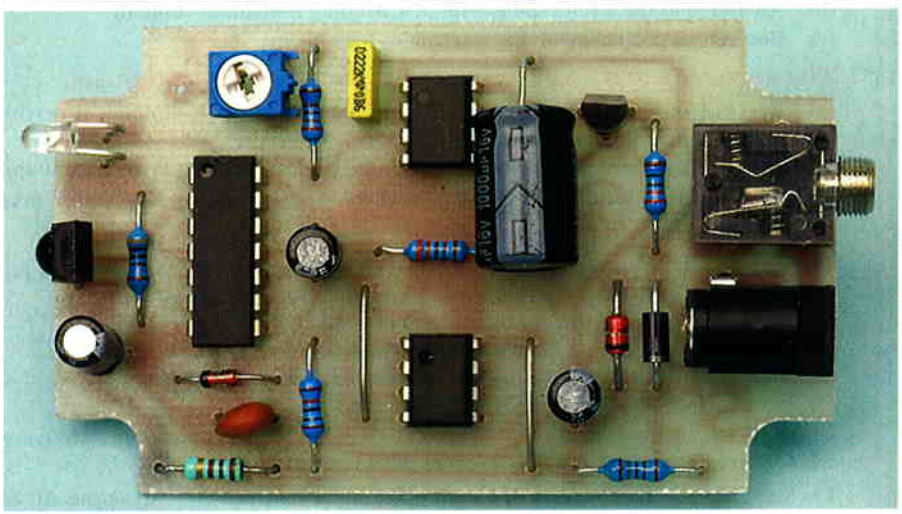
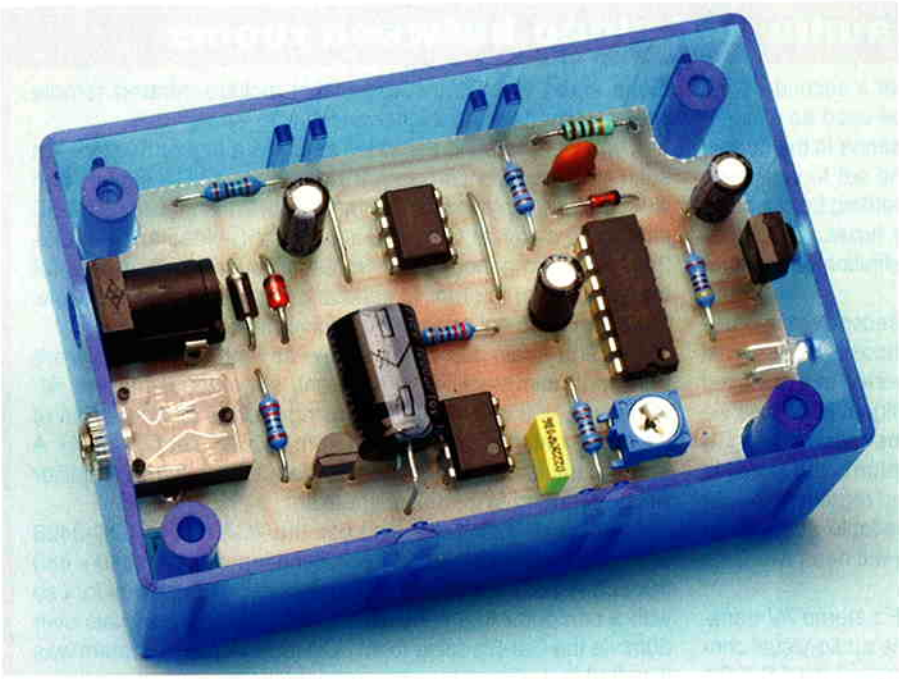


Fig. 6: here's the component overlay for the Infrared Remote Extender, with a matching photograph below. Watch those polarised components!





And here's how it fits into the UB5 box. You will need to drill holes in both ends for the IR receiver/decoder (at right in the above photo) and the power and IR LED socket. Both of these are shown in more detail below.

in a small plastic case measuring 83 x 54 x 31mm.

Begin construction by checking the PC board for any defects such as shorted tracks or breaks in the copper and for correct hole sizes. Holes for the DC socket and 3.5mm jack socket will need to be larger than the 0.9mm holes required for the other components.

Insert the links and resistors first taking care to place each resistor in its correct place. Note that if you are planning to use a 12V plugpack instead of the recommended 9V plugpack, then the 150Ω resistor will need to be 330Ω 1W instead.

Use the resistor colour code table as a guide to finding each value. You can also use a digital multimeter to check each resistor before inserting into the PC board. Solder each lead and cut the leads short against the underside of the PC board.

Now install the diodes, transistor and ICs, taking care to orient them with the correct polarity. IC1 is mounted so the top of the package is 13mm above the top surface of the PC board. The capacitors can go in next. Note that the electrolytic types must be oriented with the polarity shown and the 1000µF capacitor adjacent to IC4 must lie on its side as shown in the photograph to allow room to fit into the box.

LED1 is mounted with about a 10mm lead length above the PC board surface to allow it to be bent over at 90° and insert into a hole in the side of the box. Take care to orient it with the anode (longer lead) towards the

Parts List – Remote Control Extender

1 PC board, 79 x 47mm, coded 02110061
1 UB5 translucent clear or blue box, 83 x 54 x 31mm
1 9VDC 150mA plugpack
1 stereo 3.5mm PC-mount jack socket
1 PC-mount DC socket
1 mono 3.5mm jack plug
1 5m length of single core shielded cable
1 20mm length of 5mm heatshrink tubing
1 150mm length of 0.7mm tinned copper wire

Semiconductors
1 TSOP4136 infrared receiver/decoder (Vishay) (IC1)
1 74HC00 quad NAND gate (IC2)
2 7555 CMOS timers (IC3,IC4)
1 BC327 PNP transistor (Q1)
1 5.1V 1W zener diode (ZD1)
1 1N4148 diode (D1)
1 1N4004 1A diode (D2)
1 3mm red high intensity LED (LED1)
1 5mm infrared LED (LED2)

Capacitors
1 1000µF 16V PC electrolytic
2 100µF 16V PC electrolytic
1 2.2nF MKT polyester
1 680pF ceramic

Resistors (0.25W 1%)
1 100kΩ 1 5.6kΩ 1 2.2kΩ
1 470Ω 1 220Ω 1 100Ω
1 150Ω 1/2W
1 5kΩ horizontal trimpot (VR1) (code 502)

Resistor colour codes

No	Value	4-Band Code (1%)	5-Band Code (1%)
❑ 1	100kΩ	brown black yellow brown	brown black black orange brown
❑ 1	5.6kΩ	green blue red brown	greeen blue black brown brown
❑ 1	2.2kΩ	red red red brown	red red black brown brown
❑ 1	470Ω	yellow violet brown brown	yellow violet black black brown
❑ 1	220Ω	red red brown brown	red red black black brown
❑ 1	150Ω	brown green brown brown	brown green black black brown
❑ 1	100Ω	brown black brown brown	brown black black black brown

Capacitor codes

Value	µF Code	IEC Code	EIA Code
2.2nF	.0022µF	222	2n2
680pF	NA	681	680p

Transmitting audio and video between rooms

It is now common for households to have a second TV set that is located in another room. They can be used as a stand-alone set that receives signal from a TV antenna in the normal way. However, you may wish to connect the set to your main system in order to play DVDs or watch something from a cable or satellite receiver or from digital set-top boxes. The signal from these sources can be in either high definition or standard definition format.

A simple way of connecting these to the second set is to use a video balun with audio. In this way, the composite video signal and the left and right audio signals are converted to a balanced line using a balun style transformer. The signal is carried via Cat-5E cable using RJ45 connectors. At the receiving end, a second video balun with audio converter returns the signal to its original form. These units are passive and require no power connection. A video balun with audio is available from Jaycar (Cat QC-3424) (www.jaycar.com.au). You will need two units to send and receive.

As an alternative, you could use a 2.4GHz stereo AV transceiver. This avoids having to run wiring for the audio-visual connections. Altronics (www.altronics.com.au) sell their S-8771 transmitter and S 8792 receiver for this application. (Note that a plugpack and adaptor are required for each unit, M 9236 and M 9187 respectively).

Similarly Jaycar sell an AR-1842 transmitter/receiver for this application. Both Jaycar and Altronics also supply versions of these audio video transceivers that include infrared remote control extenders at a higher price.

If you want to send the video signal in a higher quality form such as S-video or component video or as a VGA signal, then video baluns are available for these that transmit using Cat-5E cabling. The Jaycar QC-3423 is used for S-video and the QC-3429 is for component video. Note that you require two units (of the same type) in order to send and receive via Cat-5E cable. These units do not provide for audio transmission.

Sending audio can be as simple as running speaker wires from the main amplifier to a second set of loudspeakers. Alternatively you can send audio using just the audio section of the 'video balun with audio' unit from Jaycar (Cat QC-3424). A second unit is required to receive the audio. A stereo amplifier will be required to drive loudspeakers.

For high definition, you can use the VGA baluns (QC-3428 available as a pair) to send resolutions ranging from 640 x 480 through to 1280 x 1024 pixels. We tested this VGA balun for use with a computer that sent 1024 x 768 pixel video signals over 60m via the Cat-5E cable to an LCD projector. This system was installed in a church for video presentations.

One problem was that the common ground connection on the receiving VGA balun unit had to be earthed (to mains earth) in order for it to work. When testing in the home the earthing needed to be at the sending end rather than the receiving end balun unit. You may not need to earth the balun in your application.

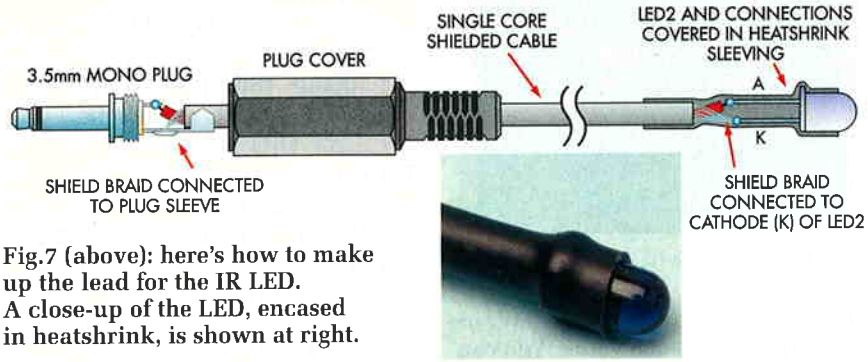

3.5mm MONO PLUG
PLUG COVER
SINGLE CORE SHIELDED CABLE
LED2 AND CONNECTIONS COVERED IN HEATSHRINK SLEEVING
A
K
SHIELD BRAID CONNECTED TO PLUG SLEEVE
SHIELD BRAID CONNECTED TO CATHODE (K) OF LED2

Fig.7 (above): here's how to make up the lead for the IR LED. A close-up of the LED, encased in heatshrink, is shown at right.

edge of the PC board. Finally, install the trimpot, the DC socket and the 3.5mm jack socket.

Installation

The PC board is installed into the small translucent plastic case. Before you can insert the PC board into the box, drill out the hole for the 3.5mm jack socket. This needs to be 10mm down from the top edge of the box and 20mm in from the edge of the box. The advantage of the clear box is that the positions for the DC socket and IC1 lens hole can be readily seen when the PC board is clipped into the box. Mark and drill out these holes and the LED hole. The acknowledge LED is bent over at 90° to insert into the hole.

We used the box upside down with the lid used as the base. The screw covers on the box act as rubber feet for the box. If you are using a different box, then use some stick-on feet on the base of the box.

The IR LED lead is made up as shown in Fig.7. The single core shielded cable is connected to the DC plug at one end and the IR LED at the other. The LED is insulated on at least one of the leads with some insulation tape or heat shrink tubing and also it is covered in heat shrink tubing but leaving the lens end exposed.

Testing

Connect power using the plugpack and check that the voltage across ZD1 is about 5.1V. If so, check that the acknowledge LED flashes when an infrared remote control is sending a signal to the Infrared Remote Extender. You can verify that the infrared LED retransmits the signal to your equipment by using the extender in another room with LED2 located near to the equipment to be controlled. VR1 may require some adjustment so that the extender works the equipment correctly. SC

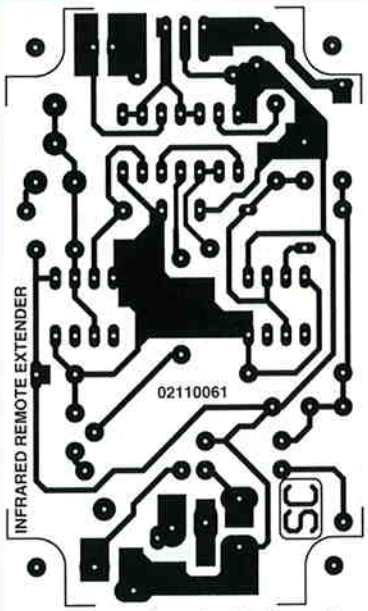


Fig 8: the same-size PC board pattern.

SERVICEMAN'S LOG

Muggins & his bargain LCD monitors

When is a bargain not a bargain? When it causes you grief, that's when. Unfortunately, I sometimes just cannot resist the temptation to buy stuff – even when it isn't working.

I was persuaded to buy a couple of good-looking but non-working ex-government 18-inch LCD TFT monitors for $30 each. Good price, you might say – well, read on.

These were 6-year old Acerview FP855 units and were pretty "schmick" in their day, with features that included a 50ms response time, VESA, DPMS, EPA and NUTEK 803299 standards, built-in speakers, a microphone and a USB hub. Their standard resolution is 1280 x 1024 and they originally sold for $4976 back in 2000!

I thought they were a bargain and immediately set about repairing them.

Both sets were dead and the switchmode power supply module in each had blown completely, although fortunately not in the same way.

Access to the power supply is fairly easy, as it's behind a panel in the stand above the USB hub. The power supply is quite sophisticated and in fact consists of two supplies which provide +12V and +5V. One is permanently on, while the other is switched on via sync pulses or a power saving signal, or via the on/off power switch. In fact, the latter supplies +12V to a sub-power DC-DC board which then produces additional +5V, +5V FIX and 3.3V rails. The +5V (power saver) then switches on the second power supply.

The 4A mains fuse F601 had blown on each unit and on one supply, FET Q601 2SK2645 had also blown, probably due to C618 (220pF 1kV) disintegrating. The 1000µF electrolytic capacitor on the secondary looked decidedly dodgy, with C703 in particular looking dark and "bulgy". Both units also had leaky main electros (C605, 150µF 400V) which may have started the chain reaction.

Further examination also revealed that the front had blown off FET IC IC605 (TOP224Y) on the second unit. So I had plenty of faults to work with.

I didn't have a circuit diagram but with two units at hand, it wasn't hard to determine what parts were what. I started with the second unit as it seemed to have less damage. I began

Items Covered This Month

- Acerview FP85S LCD monitor
- Philips 29PT4873 TV set (L9.1A chassis)
- LG29Q24PT TV set (MC-99A chassis)
- Grundig ST 70-703 NIC/TUP (CUC2030 chassis)
- Onkyo TX-SA702 stereo amplifier

TAKE YOUR PIC

www.picaxe.com.au www.MicroZed.com.au

Developed for students, & professional performance makes PICAXE the most easy-to-use micro ever: PICAXE "programmer" is two resistors and a 4.5V battery!

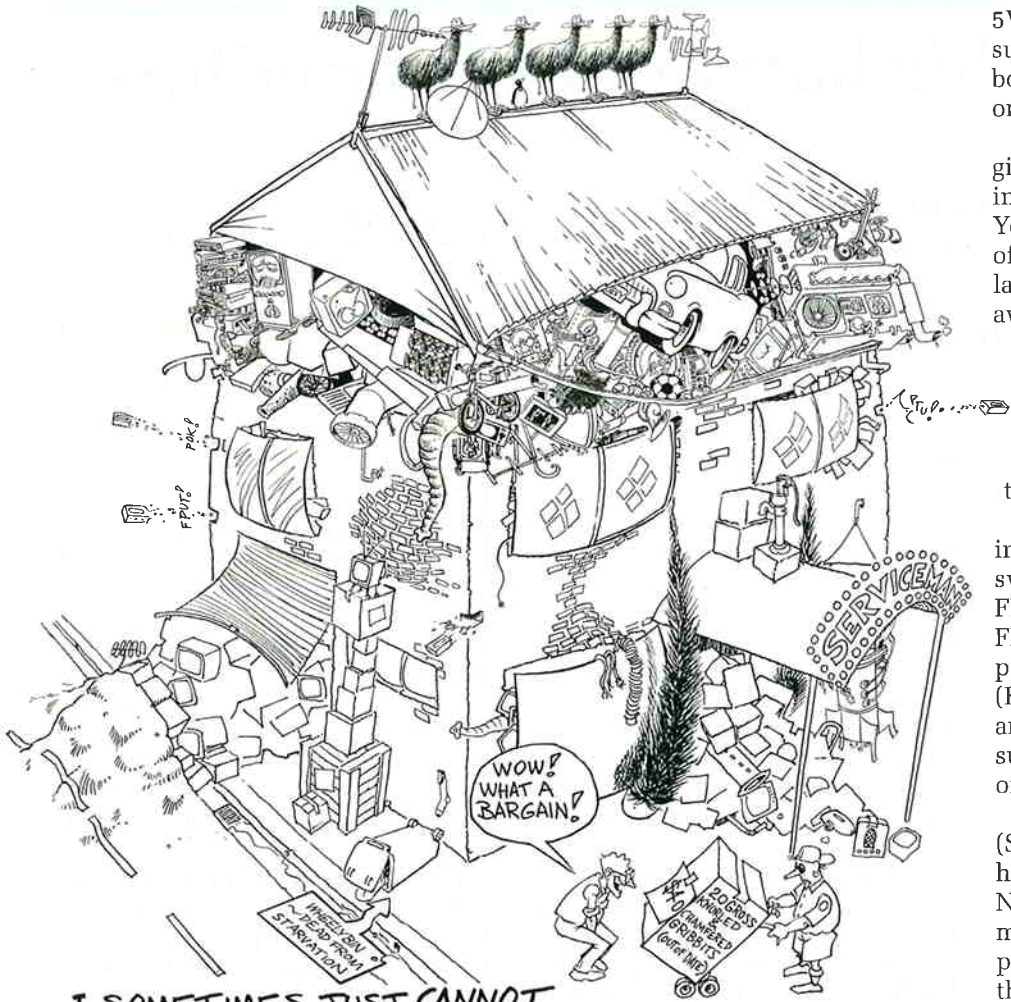
PHONE 1300 735 420
FAX 1300 735 421 24 Hours

ALL PICAXE ITEMS ON OUR SHELVES!

STOCKISTS

In AUSTRALIA:
- altronics.com.au
- oatleyelectronics.com
- School Electronic Supplies (School orders only – John - 03 8802 0628)

In NEW ZEALAND
- sicom.co.nz
- surplustronics.co.nz


WOW! WHAT A BARGAIN!
SERVICEMAN
WHEELIE YOU DEAD FROM STARVATION
20 GROSS KNOB-LED TRANSFERED GRIBBITS (QUITE MID)
I SOMETIMES JUST CANNOT RESIST THE TEMPTATION TO BUY STUFF...

by replacing the fuse, the bridge rectifier and most of the electros, after which I replaced C618 with a 220pF 6kV ceramic.

That done, the display worked perfectly so I swapped the supply over to the first unit and it worked as well.

It was then that I made a fateful mistake, all to save about $10. The control IC is a UC3842B which I mounted in an 8-pin IC socket. Anyway, I decided to test the IC from the other power supply (the one with the blown FET). Unfortunately, this blew up quite spectacularly, with flames on both sides of the PC board.

When I examined the board in a good light, I found I had blown some of the copper tracks off, plus quite a number of surface-mounted components – in short, everything within cooee of FET Q601 and IC601 which now looked like the shell of Chernobyl after its explosion!

Because surface-mounted components are difficult to work with, I drilled holes through the PC board and repaced them with conventional equivalents. In the end, I replaced Q602 (2SA733) with a BC558B, ZD601 (a 27V zener), R614 (47Ω), R626 (4.7Ω) and D604 (1N4148), as well as R605 (0.47Ω), IC601, Q607 and the copper tracks between them.

Unfortunately, this didn't fix the power supply and I only managed to continue the repair after downloading a circuit from the internet. This helped me find that find that R627 (16Ω) and R615 (1kΩ) were also open circuit.

I was only using one display to check these power supplies and had just finished getting both to work when suddenly the display turned off. The front-panel LED (8807) also turned off and the power save rail dropped from 5V to 1.4V. I then checked the power supplies in the remaining display and both were OK, which meant that the original display was now faulty.

At this stage, I really should have given up, as opening up and getting into a display unit is very difficult. You have to remove the outside layer of plastic trim and then the inside layer of metal covers, all the time being aware that the interconnecting cables are heavily clamped and the on/off switch can only be desoldered to remove the front escutcheon.

Nevertheless, I stupidly persevered until I managed to retrieve the DC-DC sub power supply.

The circuit shows that +12V is fed into IC751 (PQ1CF1) via the power switch, which converts it to +5V FIX. This is then fed to a switched FET (Q751, IRL31013), the 5V output of which is then fed into IC752 (KA78R33) which supplies +3.3V and also back into the main power supply to switch on the second part of the circuit.

The circuit also shows that orange (STANDBY) and Green (ON) LEDs are hung off the +5V and +5V FIX rails. Neither LED was coming on, which meant that there was no +5V FIX output from IC751. Unfortunately, with the whole display stripped down, it is almost impossible to power it up in this state and make measurements.

I started by checking out the DC-DC converter. At first I thought I was onto it when the ohmmeter showed a dead short on the +5V FIX rail. I subsequently spent quite some time removing suspect parts until I realised that the 2200µF electro across diode D751 was very slow to discharge.

Next, I connected an external 12V supply to the board and shorted out power switch CN752 (or CON752, depending on how you read it). This gave +5V FIX but the FET was switched off and I considered that it may be this that was failing when it was actually meant to be switched on.

Using an ohmmeter, I switched it on by biasing Q752 and Q753 and measured all the outputs (5V, +5V FIX and 3.3V) with another digital meter. These were all spot on, so the FET appeared to be OK.

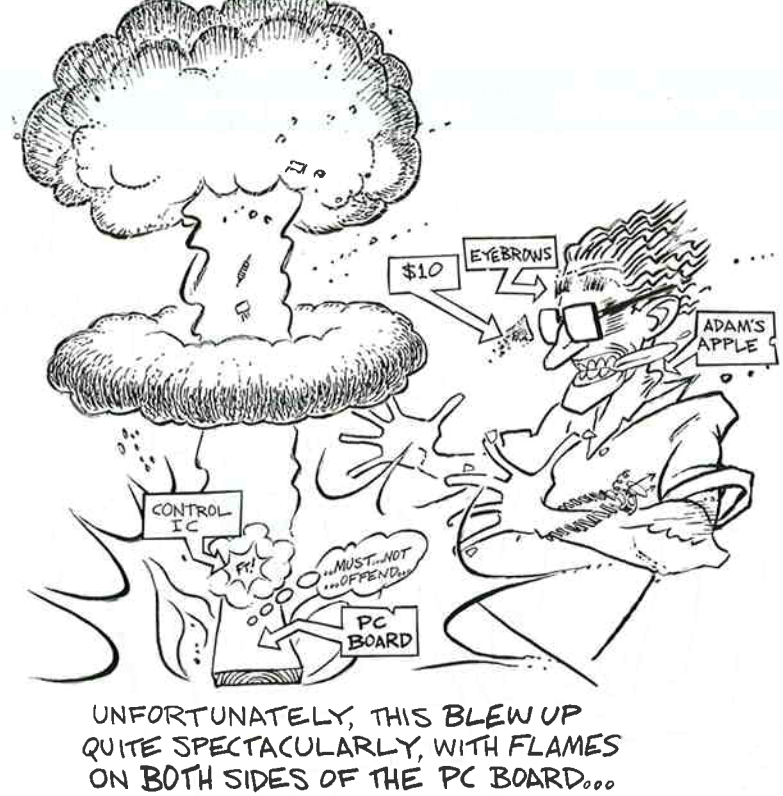
I then connected the microproces-

sor board and control board alone to the DC-DC converter and powered it up. The current drain was excessive and the +5V FIX rail dropped to less than 2V. I allowed it to stay on for a few more seconds in an effort to detect which components were under stress. This indicated that IC811 (80C32PL), the control microprocessor, was getting hot so I cut the track between the +5V FIX rail and pin 44 (V_{DD}). This +5V FIX rail now came up and the current drain dropped to a more reasonable level.

Unfortunately, I doubt I can source this 44-pin surface mounted IC, let alone change it. So I'm really up the creek on this on!

Let's do the maths. I had one working monitor out of two and had spent quite a few hours on the repair and purchased nearly $100 worth of parts. Taking into account my time, this 6-year old LCD monitor has cost me more than $300!

Brand new ones are now only $400 and working secondhand ones are currently available on eBay for around $90.00. So who is the muggins?



Intermittent Philips

A 1999 Philips 29PT4873 (L9.1A chassis) came in with an intermittent no picture fault. As a result, it was left switched on in the soak bench corner of the workshop, so that we could see the fault.

It was over a week before we actually saw the symptom and even then it was only very occasional. Eventually, I moved the set over to my workbench, removed the back and switched it on. Suddenly, there was a loud bang and the acrid smell of burning.

I immediately switched the set off and quickly discovered that the short was in the degaussing coils. What had happened was an unbelievable fluke. The aquadag on the CRT had an earth strap which was spring-loaded. The spring had suddenly fractured and the remaining part of it had retracted hard back and dug into the insulated degaussing coils and shorted them to the chassis.

Fixing this was really easy – it was just a matter of replacing the spring. No damage was sustained by the coils or the rest of the set, not even the fuse!

Now for the original symptoms. I put the set into the Service Default Mode by pressing 0-6-2-5-9-6-MENU on the remote and it displayed error code 6, which is a Bimos IC7250 TDA8844/5 I^2C error – or in other words, the jungle IC.

Well that was all fine and dandy but you don't just replace the jungle chip without firm evidence. This is a 56-pin IC with a lot of circuitry inside and an external intermittent data or clock pulse signal can be quite difficult to track down.

No picture problems are often caused by faulty vertical timebase pulses which control the blanking, so I started examining the circuits involved with this. There were no dry joints on the vertical output (IC7401) or the deflection yoke plug and socket, as can sometimes be the case. The height and linearity were pretty right so I decided to concentrate on the vertical oscillator circuit inside IC7250 which covers eight pins (45-52). However, before getting onto this, I decided to monitor the +8V supply to pin 37.

On this IC, pin 44 is a ground, pin 45 is east-west drive, pin 50 is EHT information and pins 48 & 49 are part of the IF circuitry. So I was left with only four pins – 46, 47, 51 and 52. As the deflection never changed, it really left only pins 51 (V_{SC}) and 52 (I-REF) and there are only two components on these pins – R3426 (39kΩ) and C2426 (100nF).

R3426 (which is surface-mounted) measured spot on but C2426 (on pin 52) measured only 47nF out of circuit. I replaced it and that fixed it, so I left the set on soak for another fortnight before releasing it back into the loving arms of its owner.

Finally, this fault must have been in this set from new seven years ago, as the vertical linearity and height had to be readjusted from the factory settings after changing the capacitor.

Similar symptoms

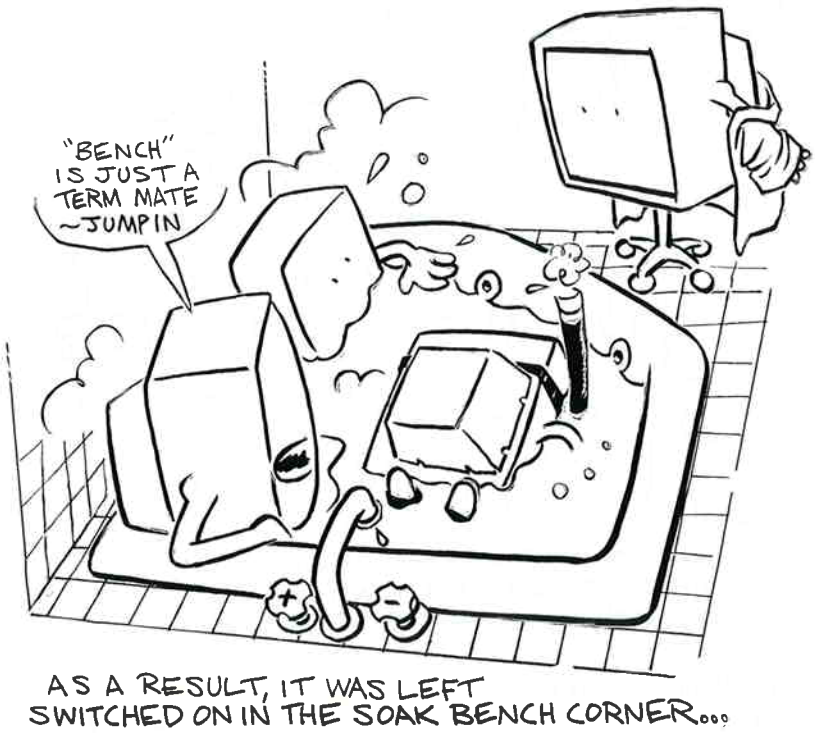
I recently had two 1999 LG29Q24PT (MC-99A chassis) TV sets come in with very similar symptoms.

The first was dead and smelt bad. This set lived near the beaches, so I went straight for the EHT stages and found Q401 (2SD1887) to be short circuit. The flyback transformer also wasn't looking too hot, with carbon tracks on the black plastic insulator.

Fairly sure that that was all, I quoted for the two items and ordered them when the owner gave the OK. They arrived a few days later and I quickly put them in.

However, that didn't fix the problem. Although there were no atomic clouds of smoke and the sound was OK, there was no picture and my new horizontal output transistor was getting hot.

At first I thought it might be one of those brown capacitors that sometimes go crook but they all measured OK. I then switched my attention to C916



(2.2nF 2kV) on the G2 screen grid of the CRT socket. This turned out to be OK and I was now beginning to suspect the CRT socket itself as it was smelling decidedly bad.

Unfortunately, by now, Q401 had given up the ghost – it had just got too hot under the collar. I replaced the transistor again and dismantled the CRT socket to discover that it had been arcing severely through the spark gap. After a small setback when C914 (1000µF 16V) decided to smoke for no particular reason, a new CRT socket finally fixed this set.

The second set also had no picture but it also had virtually no screen voltage going to grid G2 of the CRT socket.

Once again, I suspected C916 but it wasn't until I unplugged the socket from the CRT that the voltage rose to the correct level.

My CRT analyser subsequently showed that the A68QCU259X picture tube had a g1/g2 short. I gave it a blast with a CRT booster and it cleared, which was lucky. However, I was obviously not able to guarantee the repair, so I had to return the set and only charge the quote fee.

Busman's holiday

You would have thought fixing TVs all day would make watching them like going on a busman's holiday.

Recently, though, I was watching one of the current affairs type programs when I heard a number of people bleating pathetically about the cost of their large-screen televisions (rear projection/LCD/plasma), the cost of repairs and the time taken to fix them.

Their expectations struck me as ridiculous and you have to wonder where they have been for the last 20 or 30 years. First, let's look at purchasing costs.

In the UK before the war, a TV set cost much more than a house and up until the late 1950s, it was nearly on par. In the 1960s, it was the price of a car. In the 70s, 80s and 90s, it dropped to about one week's pay. Then along came the new flat-panel technology and the same thing happened. The early plasma sets cost around $50,000 a decade ago and now they are less than $2000.

In 1974, a secondhand Pye Pedigree black and white TV sold for about $350. In 1976, a portable colour TV was $500, while the same item with a remote control is now just over $100. And this is all without taking inflation into account.

Furthermore, the reliability of sets in the early 70s and earlier was nothing like it is today. Many black and white TVs broke down three or four times a year and many people took out service contracts.

The advent of Japanese-made sets resulted in huge gains in reliability – so much so that you would be unlucky if the set broke down more than once in three years. As a result, service contracts were dropped in favour of extended warranties.

On average, the life of a CRT TV set is about 10 years and many of these now make the distance with only one or two problems (if any). In fact, most are dumped because of new technology rather than because they've failed.

Some observers have forecast that plasma and LCD TVs will have a lifetime of 20-30 years. However, each new generation is better and cheaper than the previous one and they have more features as well, so you just won't want to keep them that long.

The major downside of all this incredibly cheap hardware is the cost of repairs. They are no longer repaired to component level and exchange boards have to be sourced from overseas and are sometimes difficult to get, as well as being expensive. Software upgrades are also important these days and you need the support of the manufacturer to do this.

In all this, the service industry is being squeezed, with shrinking returns and less support than ever. Repairs are no longer made in the home – the set has to be repaired at a service centre and this can take a long time. The manufacturers are also being squeezed, with very few now doing their own service. Instead, they have subcontracted the repairs out to agencies and these agencies are being rationalised and reduced in number.

So when I hear people weeping crocodile tears about how terrible it is that their sets are costing so much to buy and maintain, my retort is to go and get a life. Really, the consumer has never had it so good.

Pillar to post

I was recently pushed from pillar to post with a couple of difficult Grundig repairs and was no sooner finished when another one arrived in the workshop. This was a dead ST 70-703 NIC/TUP employing a CUC2030 chassis.

Apart from a few suspect solder

joints, I could only initially find two fuses that had gone open circuit. One was the main 240V AC power input fuse (2.5AT, SI62501), while the other was in the +330V feed to the switchmode power supply (0.6AT SI60001).

Well, for two fuses to go there must either be something quite wrong here or the set had been subjected to a major power surge. I couldn't see anything particularly wrong, so I disconnected the degaussing coils and fitted a 200W globe in place of SI62501. I then fitted a new fuse in the other holder.

When I nervously switched it on, smoke and sparks came from the switching FET (T60006, BUZ90). I switched it off too late – SI60001 had blown again.

When I removed the FET, I found that the rubber wafer underneath it had been punctured and was arcing through. I cleaned up the pitted metalwork, fitted a mica wafer smeared with thermal transfer grease and resoldered the transistor. This time, when I switched it on, there were no more pyrotechnics and the set performed smoothly.

It just goes to show that not every job is a @#$%^&*!

Onkyo amplifier

Our audio technician was recently confronted by an Onkyo TX-SA702 stereo amplifier. The problem was distortion on high peaks and this was even more apparent on the CRO.

Strangely, the fault was evident in both channels so he started by troubleshooting the lefthand channel and again found the fault almost by accident. Following the signal, he placed the CRO probe on the base of Q6050 (2SC5200) and noticed that the distortion level varied depending on how hard he pressed the probe on the soldered joint.

At first glance, the soldering looked perfectly OK but pressing the transistor's base lead definitely varied the distortion level. He unsoldered the base and found that the copper pad underneath had corroded and hadn't tinned properly when the pad was originally soldered.

The rest was an anti-climax. Cleaning the pad and resoldering it fixed the problem and repeating this fix on Q6051 in the right channel also fixed that channel. SC

LTW
Harsh Environment Connectors
www.ltw-tech.com
C-16 Line
D-Sub Multipin
Multipin Circular Line
Multipin Circular
C-16 Style
RJ45
Miniature DIN
Available in Australia from Altronic Distributors
Agricultural • Industrial • Mining • Marine
LTW connectors represent the ultimate in value and reliability for manufacturers of industrial equipment requiring waterproof connectivity.
Available in IP66, 67 & 68 ratings for use in almost any environment.
Altronic Distributors carry a range of products ex stock (see website for range available). Other LTW models available upon request. Minimum quantities apply.
ALTRONIC DISTRIBUTORS PTY. LTD.
Sydney Melbourne Perth
Phone: 1300 780 999
Web: www.altronics.com.au

microbric™ ViPER
The Microbric Viper is a perfect entry point into robotics and programming, or the ideal compliment to your existing robotics line up!
All modules are fully assembled, meaning there is no need for a hot soldering iron to build your robot. This makes the Microbric Viper perfect in an educational environment.
The Microbric connection system means fully reusable modules can be put together and taken apart quickly. Microbric requires nothing more than the supplied screwdriver to assemble, making it possible to have an operating robot in less than one hour!
The Viper is controlled by a BasicAtom.com microcontroller, which is programmed in 'BASIC', an easy language to learn the fundamentals of robotics programming.
Remote Control Robot
Bump Robot
microbric™
www.microbric.com
Available At
DICK SMITH ELECTRONICS

PICAXE Net Server – Pt.2

By CLIVE SEAGER

Control your next electronics project from virtually anywhere on the planet!

Last month, we described the basics of the PICAXE Net Server (PNS) and built a simple demo board which we then controlled over a local network. This month, we look at how to access the PNS over the Internet.

ONCE YOUR PICAXE Net Server is up and running on the local network, you'll no doubt be keen to expand your horizons and control it externally – from a remote location over the Internet. This article describes how to configure a "typical" home network and how to make use of various Internet-based services to enable remote access to the PNS.

A diagram of the network we'll be referring to in this article appears in Fig.1. Note that this is not intended to represent the ideal layout but rather is presented as an example. In fact, some of the devices mentioned are now quite a bit out of date!

Nevertheless, it's typical of the network found in many homes.

Connection to the Internet is made via an "always on" cable modem, while a webcam is included so that the author can check that the PNS is behaving as expected. A Panasonic BL-C10 webcam was selected because it can broadcast images without the need for a computer connection. Obviously, you won't need a webcam for your setup!

Before we explain how to configure the network to support the PNS, it is useful to identify each component and briefly describe its function within the network:

Cable modem (Motorola SurfBoard 4100): in simple terms, the cable modem's job is to convert the signals on the carrier's cable network in the street into signals compatible with the local computer network in your home.

When the modem is plugged in and connected to the computer (or router), your ISP automatically allocates the connection an IP address by a process known as DHCP. We described this process briefly last month.

To avoid confusion, we will refer to this address as the "public IP address", as it is visible externally to other computers on the Internet. In most cases, this address will be dynamic, meaning that it will change often – perhaps every time the modem is switched on. For convenience, we

will use 82.83.84.85 as the public IP address in our example network.

Cable/DSL router and switch (LinkSys BEFSR41): if you just want to connect a single computer to the cable modem, you do not need a router/switch, as the computer is simply plugged directly into the modem. However, when you want to share the Internet connection with other computers or add a PICAXE Net Server, then more than one connection is required.

This is where the router/switch comes in. It allows multiple devices to share the same public IP address (the "router" part) and provides five physical connection points for extra computers and the PNS (the "switch" part).

Taken together, the modem, router/switch, computers and the interconnecting cables constitute a small home network. Each device on the network is given a local IP address, which in the examples shown is selected from the range 192.168.1.x. All devices are assigned a subnet mask of 255.255.255.0 and a gateway address of 192.168.1.1.

Note: last month, we used the address range 192.168.0.x (where x = 1-254) instead of 192.168.1.x for all of our examples. Either address range is valid for a private local area network. In other words, it would be equally valid to use addresses in the 192.168.0.x range here.

However, it is probably easiest to use the range that will work with the default settings provided with your router. In this case, the LinkSys router has a default address of 192.168.1.1, hence our choice. Whichever you choose, remember that all devices on the same network (including the router) must have addresses in the same range!

The router can also act as a DHCP server for the local network. This means that it will automatically issue IP addresses to computers as they are connected to the network. Using its default settings, the BEFSR41 router will issue addresses in the range 192.168.1.100 - 192.168.149, so in theory your network could consist of up to 50 computers with dynamically assigned IP addresses.

Note that the router has two IP addresses - the public IP address (82.83.84.85) and the local IP address (fixed at 192.168.1.1). The router shares the single public IP address between all of the local network devices via a method called "NAT" (Network Address Translation). We'll come back to this in more detail shortly.

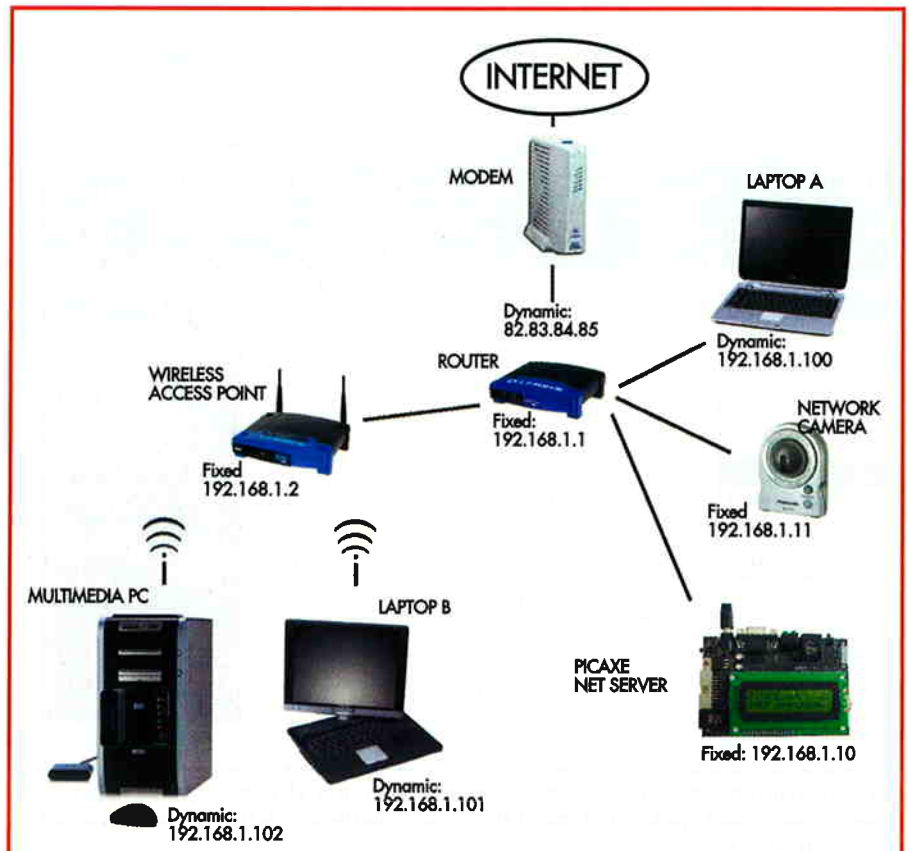


Fig.1: here's the layout of the network described in the text. Many home networks will use a combined modem, router and switch, simplifying the layout considerably. The wireless section is obviously not needed for a basic set-up but we've shown it here because most networks will now include wireless components.

Many of the router/switch settings can be tailored to suit your network and can be accessed via a HTML (web-based) interface built into the router/switch. To access the settings, open a browser on any of the computers connected to the local network and type in the router/switch address, which in this case is: **http://192.168.1.1**

You will then be prompted for a user name and password (Fig.2). For LinkSys systems, the default user name is empty and the password is admin. The default configuration page then appears (Fig.3).

Wireless access point (LinkSys WAP54G): a wireless access point (WAP) enables PCs, notebooks, PDA's, etc, with wireless (or "WiFi") networking capability to communicate with the wired network. The WAP connects to the switch via CAT5 cable and retransmits the information on the cable in "wireless" format to/from wireless devices on the network.

As shown in Fig.1, the WAP has been configured with a fixed IP ad-

Fig.2: the router's setup menus can be accessed with a web browser from any computer on the local network. You'll need to know the IP address, user name and password. Check the router's documentation to discover the defaults.

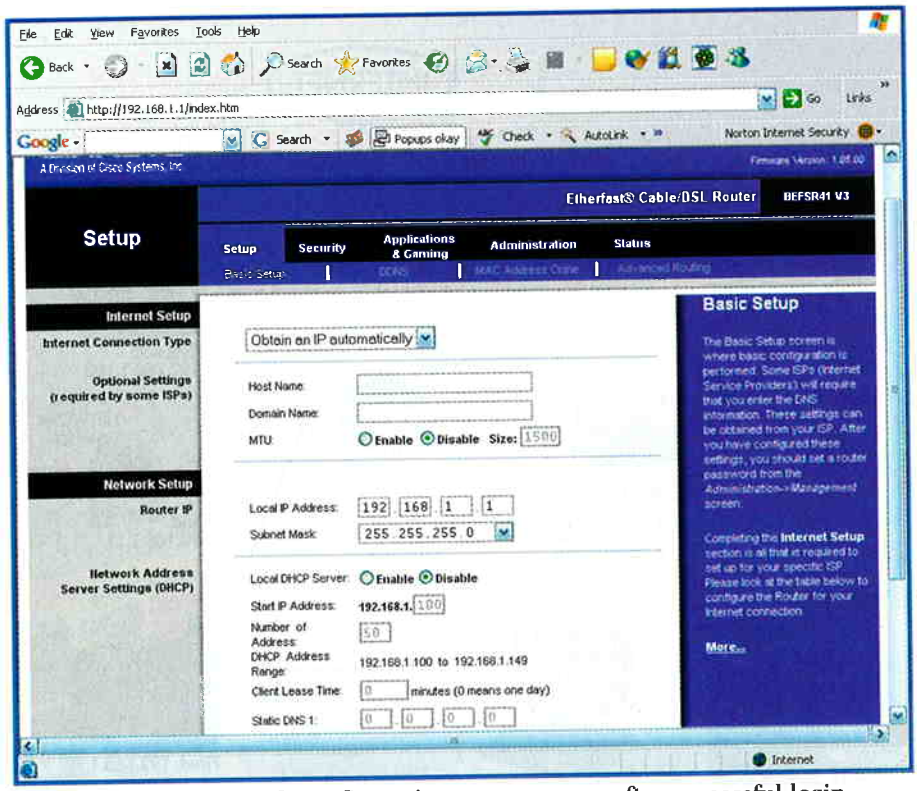


Fig.3: the router's default configuration page appears after successful login. Other models will look different to this, but nonetheless will give access to all of the relevant settings.

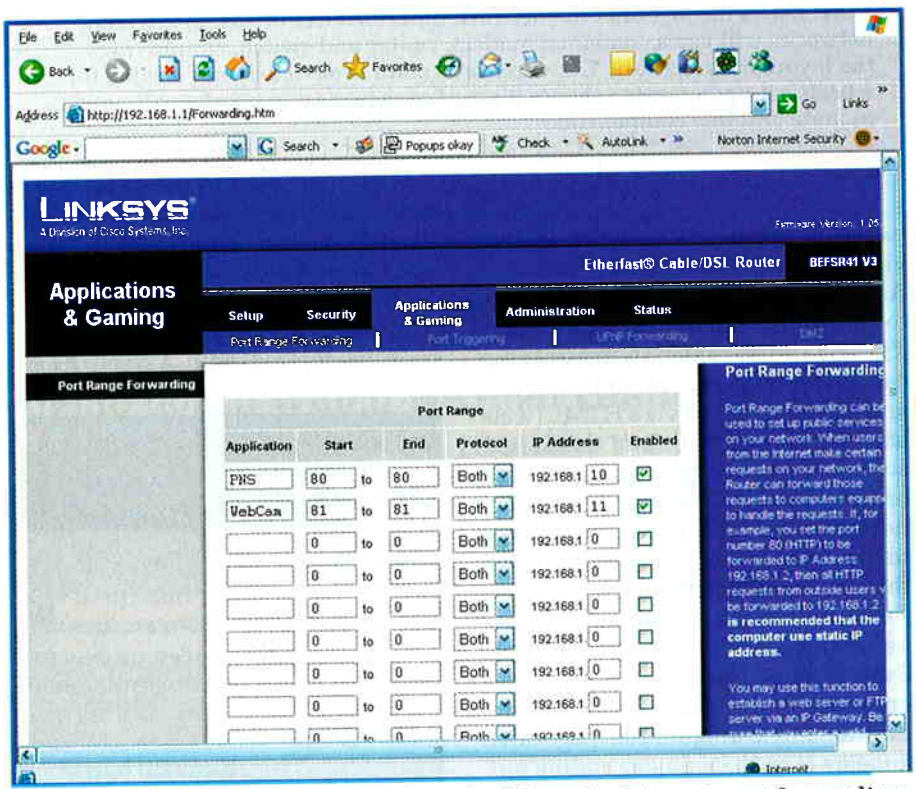


Fig.4: before access to the PNS can be gained from the Internet, port forwarding must be set up correctly. This shot of the LinkSys router's "Applications & Gaming" page shows the two entries needed for the example network.

dress of 192.168.1.2. All devices using fixed IP addresses on this network use addresses below 192.168.1.100 so as not to conflict with the address range used by the DHCP server.

Note that for the inexperienced, WiFi networks can be difficult to install, so we suggest that you connect your PNS to a wired part of the network initially.

Combined functions

Those setting up a new network should be aware that it is now possible to buy a wireless access point, router and switch in a single package (eg, LinkSys WRT54G Cable/DSL Wireless Router Switch). The ADSL equivalent (LinkSys WAG54G) even includes the modem!

These combined devices would be more economical that purchasing the two (or three) separate items described here.

All about NAT

The router used in our examples includes a function called Network Address Translation. Basically, NAT shares the single public IP address given to the router with all the devices on the local network.

When any computer communicates with the Internet, it sends out data in parcels called "IP packets". In our network, these packets must pass through the router on their way out to the Internet.

Each IP packet starts with a header containing the source and destination addresses and two port numbers *(source address, source port, destination address and destination port)*. This combination of numbers defines the TCP/IP connection between the two devices (eg, your computer and the destination web server). The addresses specify the location of the devices at each end and the two port numbers ensure that each connection between this pair of devices can be uniquely identified.

The source address will initially be the local IP address (eg, 192.168.1.100 from Laptop A). The router must change this source address on every outgoing packet to the public IP address (82.32.84.85). At the same time, it also renumbers the source port number so that each packet is unique. This allows the router to keep track of each device connection.

The router uses a port-mapping table to remember how it renumbered the ports for each device's outgoing packets. This port-mapping table relates the device's real local IP address and source port plus its translated source port number to a destination address

and port. Using this table, the router can therefore reverse the process for returned packets and hence direct them back to the correct device on the network.

This process may seem complicated but it's actually invisible to the end user. In our network, any one of the computers can surf the Internet as if they were individually directly connected to the modem!

Interestingly, NAT technology also boosts security. As computers on the local network are not connected directly to the Internet, it's harder for hackers to gain access to them. Of course, you should still run personal firewall and anti-virus software!

So we can see how devices within the local network can communicate with the Internet, but what about requests from outside the network coming in to the router?

Port forwarding

With our PICAXE Net Server (PNS) hooked up and working on the local network, we're now ready to access its web pages from the Internet.

However, we cannot use the 192.168.1.10 address to access the PNS from outside our local network, as this address is considered private and will be ignored. Initially, we cannot use the router's public IP address (82.32.84.85) either, as it does not have any information on how to deal with externally generated requests. In particular, the NAT function deals only with communications that were initiated from the local network; hence, it will ignore such requests.

This issue is overcome by a process called "port forwarding". When this feature is enabled, the router is configured to redirect any unknown packets received on a particular port to a fixed IP address within the local network. Often this would be to a conventional computer running a web or FTP server but the process works equally well for the PNS.

The PNS operates on the standard HTTP port (port 80) and so the router should be configured to forward any unknown packets destined for that port to the PNS IP address – in this case, 192.168.1.10.

With port forwarding enabled and redirecting packets for port 80 to the PNS, the PNS web pages are accessed simply by referencing the router's public IP address. So in the case of our example network, we could access the PNS home page from anywhere on the Internet by using the address **http://82.83.84.85**.

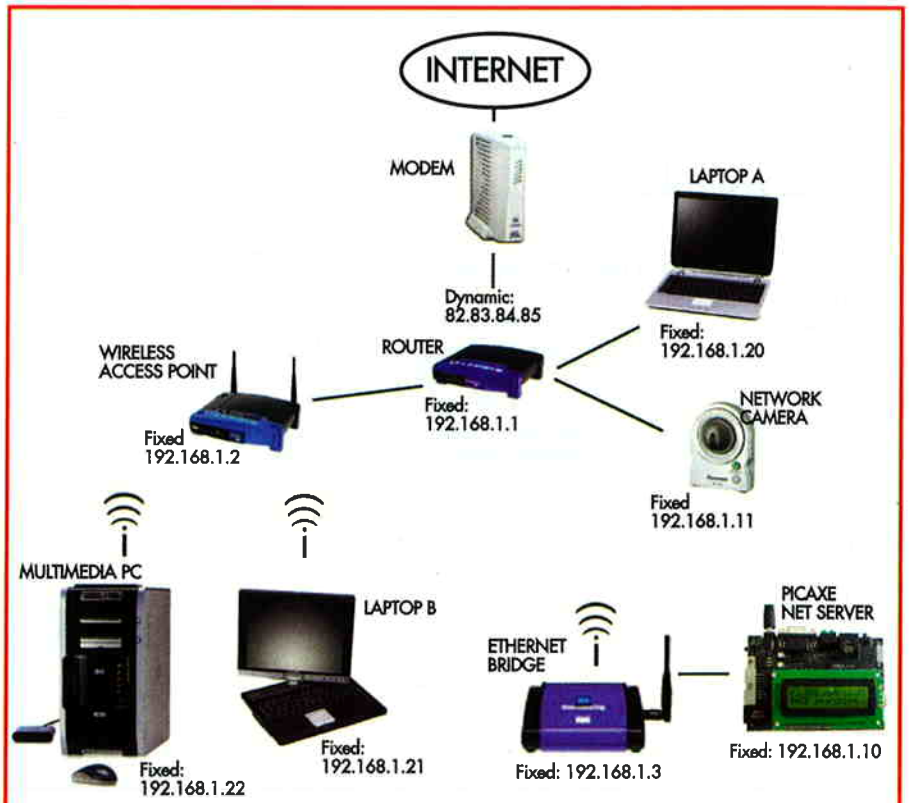


Fig.5: the router's DHCP server function had to be disabled to sidestep a design limitation, meaning that all devices now needed fixed IP addresses. Here's the result. Note how the author also moved the PNS to a wireless part of the network by adding a wireless Ethernet bridge.

Limitations

There are a couple of limitations to port forwarding. First, fixed IP addresses must be used for the devices that are to receive the forwarded packets. Second, only one device is allowed for each port number. However, this is not a major limitation because many devices allow the port number to be assigned manually.

Such is the case for the Panasonic webcam, for which we assigned port 81 to prevent a clash with the PNS. In our network, the router's port forwarding rules now contain two entries:

- Port 80 packets forwarded to 192.168.1.10 (PNS).
- Port 81 packets forwarded to 192.168.1.11 (webcam).

Fig.4 shows this arrangement, which can be found under the "Applications & Gaming'" tab in the BEFSR41 router's setup.

To access devices on a port other than the default (port 80), you must include the port number as part of the IP address. For example, to access the webcam on port 81, you would type **http://82.83.84.85:81** into your web browser (note the ":81" after the IP address).

Note: some ISPs (Internet Service Providers) block incoming requests on port 80 to prevent home users running their own web servers. If your ISP inconsiderately does this, you will need to use a webpage "redirector" service (eg, WebHop at **www.dyndns.com**) that redirects all port 80 traffic to another port.

For example, you could redirect all port 80 traffic to port 81 and run the PNS firmware set-up to reflect this change. Refer to the "Advanced Manual Configuration" section of the PNS technical manual for more information on how to change the port number.

Reliability issues

After setting up the network exactly as described here, the author was disappointed by its apparent lack

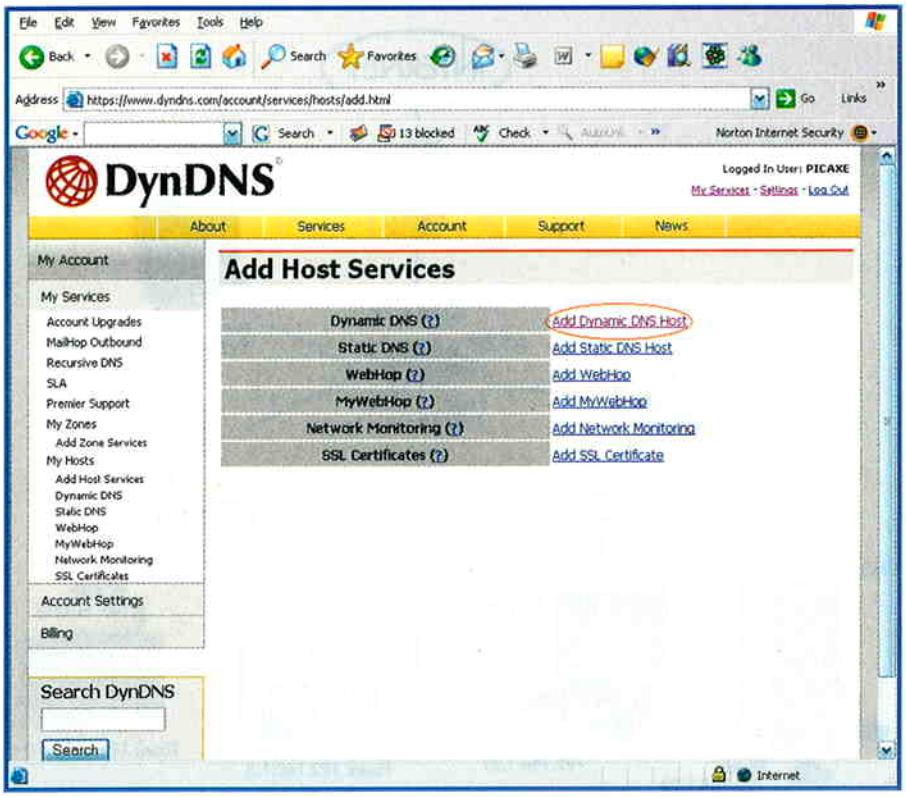


Fig.6: most ISPs don't supply a fixed IP address with their home Internet services, so you'll need to set up a dynamic DNS service for use with the PNS. After you've created an account on the chosen provider's website, click on the "Add Dynamic DNS Host" option. The screen shots shown here are for www.dyndns.com – other sites will provide functionally equivalent options.

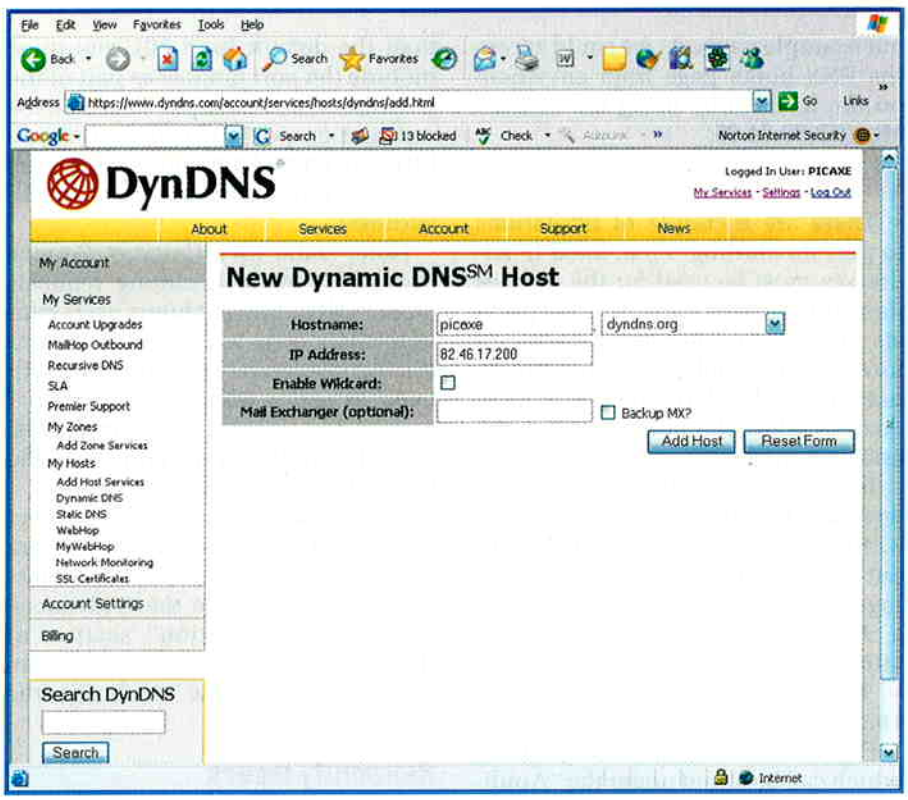


Fig.7: in this example, "picaxe" is chosen as the hostname, allowing the PNS to be accessed at the address http://picaxe.dyndns.org. The IP address is the public Internet address of your router (shown here as 82.46.17.200).

of reliability. Often, web pages would mysteriously become unavailable.

A closer examination of the user's manual for the router revealed that the DHCP feature should be disabled while using the port redirection feature. Apparently, this particular model lacks the necessary performance to drive both features simultaneously.

Disabling DHCP fixed the reliability issues and it's unlikely that you will experience this problem unless you have the same model router! Anyway, with DHCP disabled it was necessary to assign fixed IP addresses to all devices on the network. The updated network diagram in Fig.5 reflects these changes.

Fly meets ointment

There is one big flaw in the process described above – most ISPs do not provide fixed IP address to home users, so the router's public IP address is dynamic and likely to change at any time! Without knowing the router's current IP address with any certainty, it is obviously impossible to guarantee reliable access to the PNS from a remote location.

While it is possible to purchase a fixed IP address with some types of Internet services, this option is expensive and probably unnecessary for the home network.

Fortunately, a cheaper solution is to be found in a web-based service called "dynamic DNS" (DDNS).

Simply put, this service automatically keeps track of your changing IP address while allowing you to use an alternative, easy-to-remember address that never changes. At least two large providers offer this DDNS service: **www.dyndns.com** and **www.no-ip.com**.

The service is available free or charge; all you need to do is register and set up your DDNS service on the provider's website. Fig.8 shows this process, called "adding a host level service", on the **www.dyndns.com** website.

Once the service is up and running, you can use an address like **http://picaxe.dyndns.org** rather than the more obscure **http://82.83.84.85** to access the PNS!

Clearly, this system only works if the DDNS provider knows your router's public IP address and that in turn means they must always be notified when the IP address changes. While you can update the IP address manu-

ally via the provider's website, it is far better to set up a system to perform the updates automatically. There are two ways to do this: (1) via a small client program running on a computer within the local network; or (2) via the router itself.

The client program approach is the easiest, since you simply download the program from the DDNS provider's website, run it on any computer within your local network, enter a few details and then leave it running in the background.

In operation, the client program regularly checks the router's IP address and updates the DDNS server when it detects a change. For reliable operation, it must always be running when the PNS is running. This usually isn't a problem because the program is small and unobtrusive.

The second approach is to configure your router to update the DDNS details directly. This is more difficult to set up but is ideal if you want to have the PNS on all the time, even when all other computers on the network are switched off.

First, you need to check which DDNS provider is supported by your router; each manufacturer tends to support only one or two. For instance, LinkSys products favour **www.dyndns.com**, while D-Link favours **www.no-ip.com**. Check your router's documentation before registering!

Fig.9 shows how to setup DDNS on the LinkSys BEFSR41 router. Once configured, the router will automatically inform DynDNS each time the public IP address changes. Hence, the **http://picaxe.dyndns.org** address will always point to the correct IP address and the PNS!

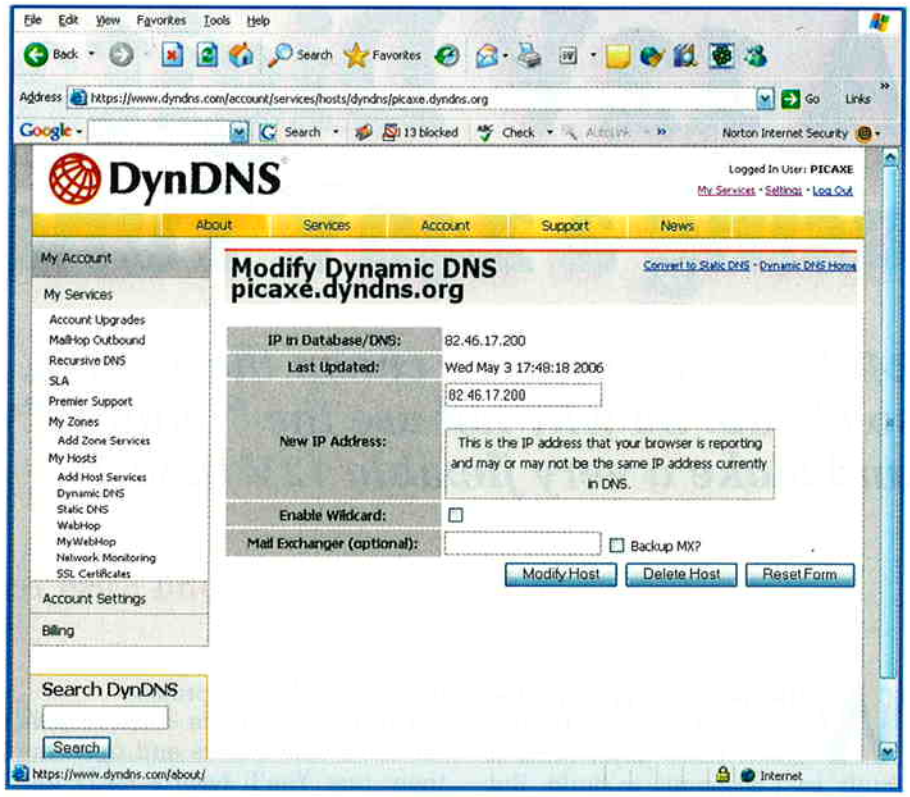


Fig.8: once the DDNS service is set up, you must notify the provider whenever your router's IP address changes. Although this can be done manually, as shown here, it makes more sense to do it automatically, either via your router or a small client program.

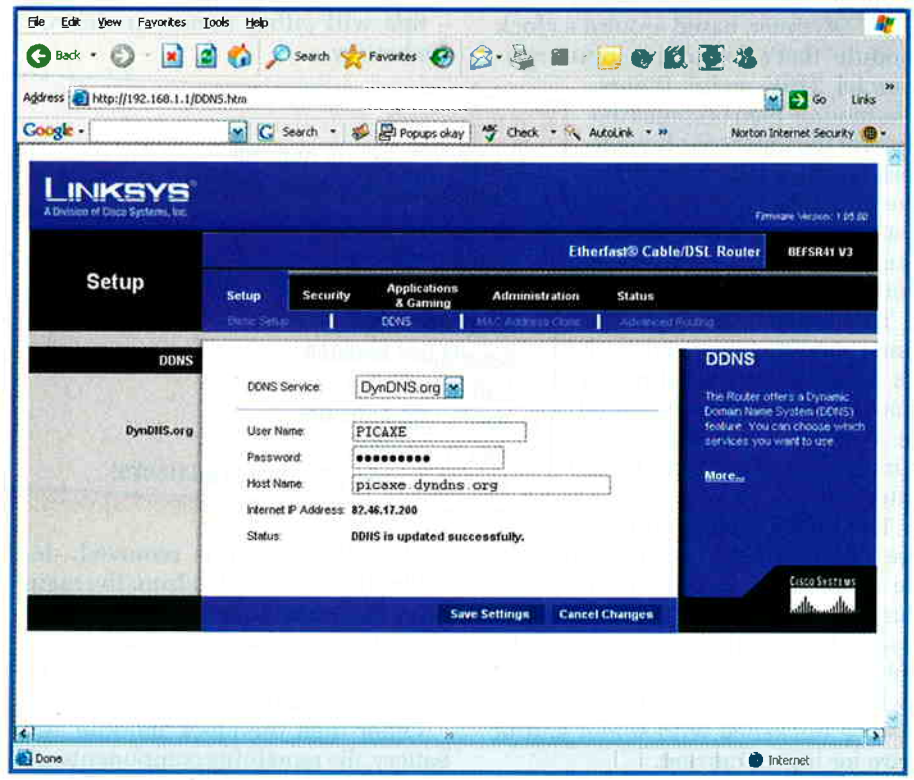


Fig.9: it only takes a few seconds to set up automatic DDNS updating on the LinkSys router.

Summary

Hopefully, you have been able to successfully apply the information presented here to your own network and can now access the PNS web pages from anywhere on the Internet. If you have connected the demo board described last month, you'll now be able to see the temperature and light level in your house from anywhere in the world!

An example of a PNS setup like this is available to view at: **www.rev-ed.co.uk/picaxe/pns/index.htm**.

Coming next month

OK, we're out of space for this month. In Pt.3 next month, we take this idea further and look at building our own web pages and control systems for home automation projects. **SC**

A 12V Digital Timer using a 240V Timer Module

240V timers are very cheap these days. 12V timers are not so cheap. So why not use the "innards" out of a 240V timer and make a very flexible 12V timer?

by Bill De Rose* and Ross Tester

With the price of imported electrical and electronics goods these days, often it simply isn't economic to build. But there are times when those same imports can yield components which make other do-it-yourself projects viable.

Such is the case with this project. It's a 12V DC timer, based around a clock module that's found in some commercial 240V mains timers. The module then becomes the heart of the timer enabling the user the flexibility to program the unit with ease. Its output controls a relay which in turn can be used to switch a low voltage such as 12 VDC.

The project consists of the timer module, removed from an Arlec PC697 digital mains timer, which is then mounted in a Zippy box along with a simple power supply and relay interface.

The SPDT relay contacts are rated at 10AC (120V) but we'd be loathe to try to switch this sort of current and expect any sort of longevity. A higher-rated relay should be substituted if heavy currents are to be switched. The PC board tracks should also be thickened with solder and/or wire for higher current.

The timer components

The Arlec timer has to be partially dismantled in order to retrieve the clock module and back-up battery; both are used in the project.

This is quite simple. First, remove the three case screws and open the timer case You'll need a fairly fine Phillips screwdriver to do this.

Next, remove power from the timer by carefully de-soldering the back-up battery. In the process be careful not to short out the battery terminals – this will either flatten or destroy the battery.

Features

- Simple to program and use
- Timer for – 24hrs daily, weekday, weekend or 7 day setting
- 10 off & 10 on programs with 1 minute increments
- Random setting
- Daylight saving advance function
- Override switch
- Countdown function
- Battery back-up
- On/off LED indicator
- Power – 12VDC
- 5A rating (10A with thickened tracks)

Once the battery is removed, de-solder the ribbon cable from the main relay PC board. Carefully remove the silicone glue around the base of the cable with a craft knife or similar. The cable should now pull free.

Other then the clock module and battery, the remaining components are not used in this project. We haven't thrown ours away – they look too good for that and we're sure that another project will suggest itself.

You can also salvage a few other components from the PC board (unfortunately the 24V relay is unsuitable for our timer project).

The Circuit

The circuit for the Digital Clock Timer is shown in Fig.1. It comprises the digital clock module, current-limiting circuitry for the rechargeable battery (also removed above) and a handful of other components used for power supply decoupling, limiting and driving the output relay.

The clock module is the heart of the project, providing all the timing and program functions. There are five connections to the module: power (+ and 0V), the LED indicator (anode & cathode) and signal output.

Let's start with the module. We'll assume the board is assembled. Inserting jumper switch S1 will switch power directly from the back-up battery to pin 3 of the module. At this point, the display should come to life and allow the user to program the clock functions.

In order for the module to operate the relay (once programmed), external power (12V DC) will be needed. Diode D1 protects the circuit from reverse polarity connection while zener diode ZD1 limits transient voltages to 15V. The 10Ω series resistor limits the cur-

rent flow if the zener diode becomes clamped. Both the 100µF and 100nF capacitors decouple the supply.

Pin 5 of the clock module is internally connected to the anode side of the LED indicator (pin 4 is the cathode [K]). The 1.2kΩ resistor limits the LED current to about 7mA, more than enough for adequate LED brightness and at the same time helps to keep the overall standby current to a minimum.

Here's how the timer module starts out in life – as the "works" in an Arlec PC697 digital timer. The module, which is a separate assembly at the top of the timer (as seen here) is easily removed from the "case". The rest of the device isn't used – but we're sure a use will turn up for it shortly!

When the clock module is in standby mode – in other words all programs and functions in the 'off' state – pin 1 is held low, pulling the cathode of D4 low and thus turning it on. This removes drive from the Darlington transistor (Q1), switching it off In turn, the relay (RLY1) remains in its rest position and the normally closed (NC) and common contacts are closed.

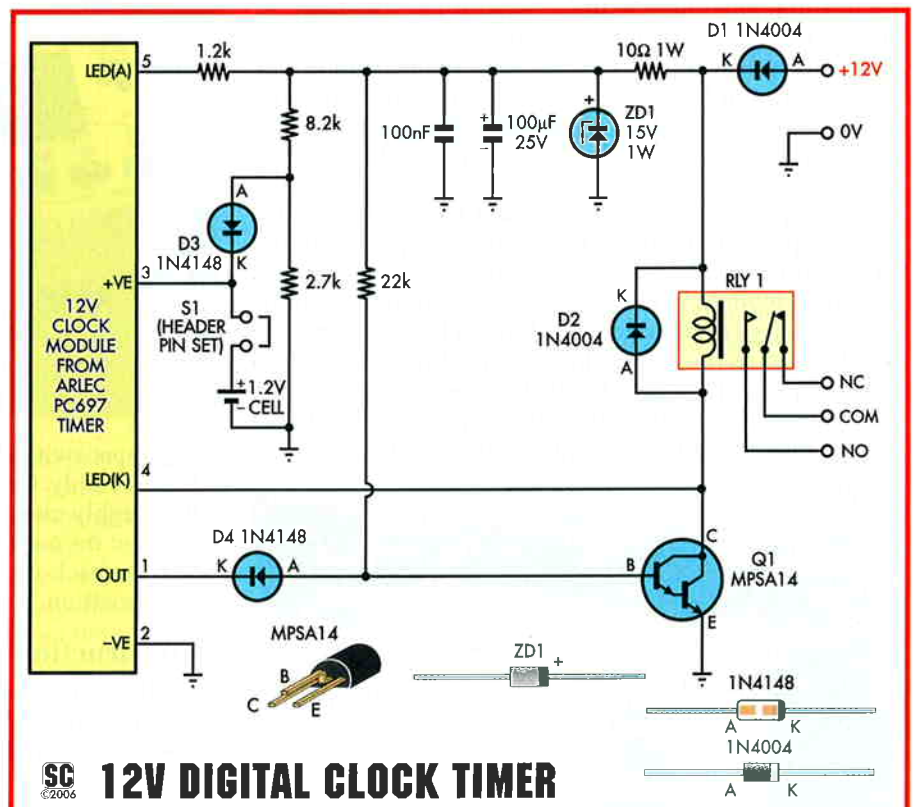


Fig.1: the circuit diagram is essentially a power supply and relay driver with all the smart work being done by the commercial timer module.

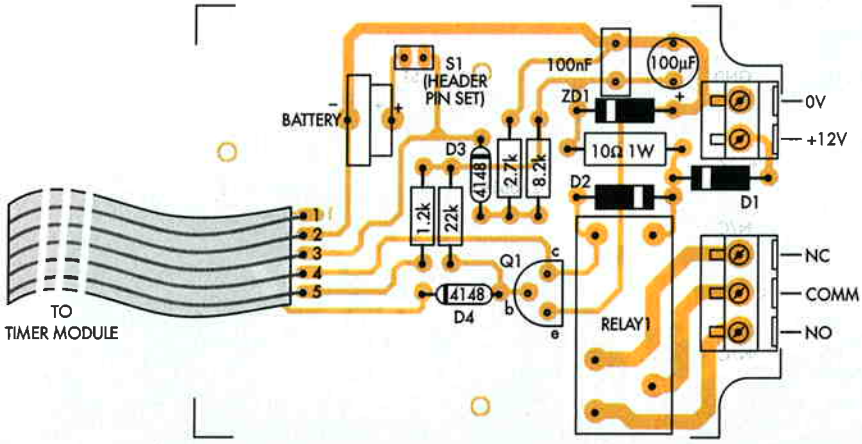
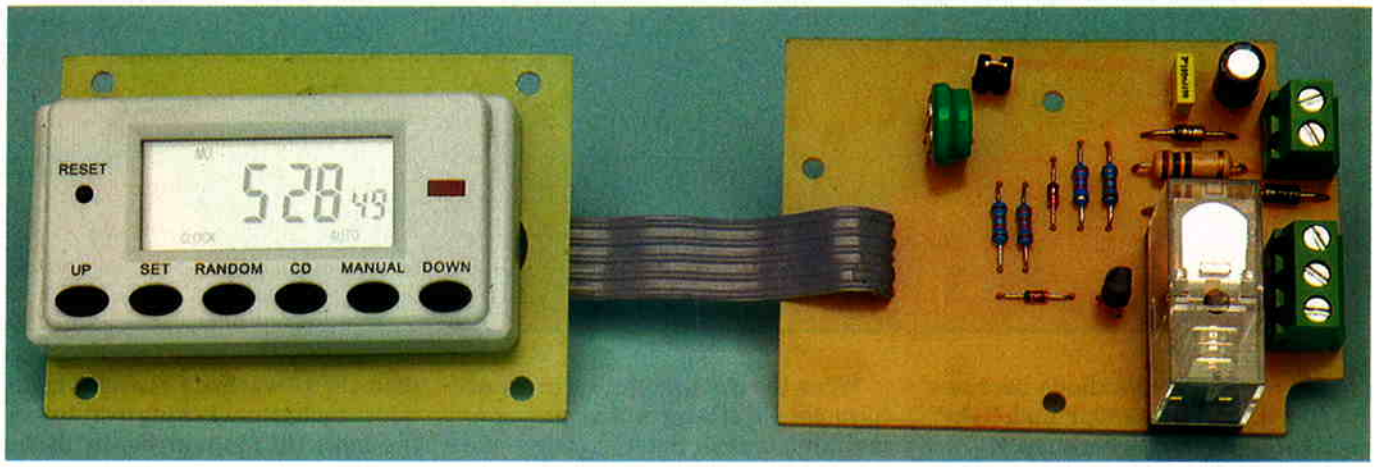


Fig.2, left, shows the component overlay for the main PC board. No overlay is shown for the display board because it has no components on it – in the photo below, you can see both boards, with the timer module, "opened out" – immediately before being assembled, as shown in the photos below. The top photo shows the completed project, from the front, ready for the front panel (actually the box lid!) to be attached, while the bottom photo is complete with the front panel on, ready to be placed inside its Zippy box. In the kit version, a silk-screened metal panel will be supplied.

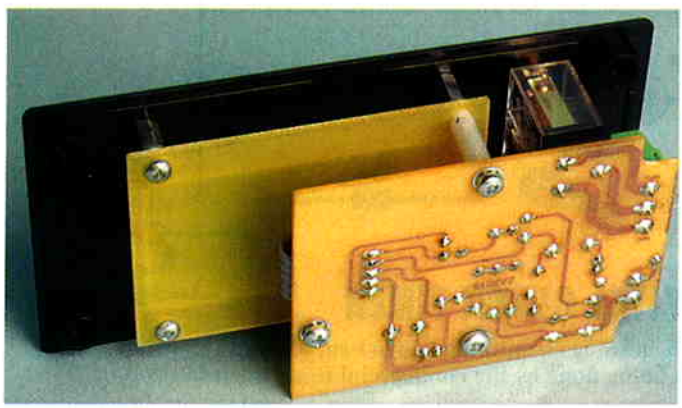


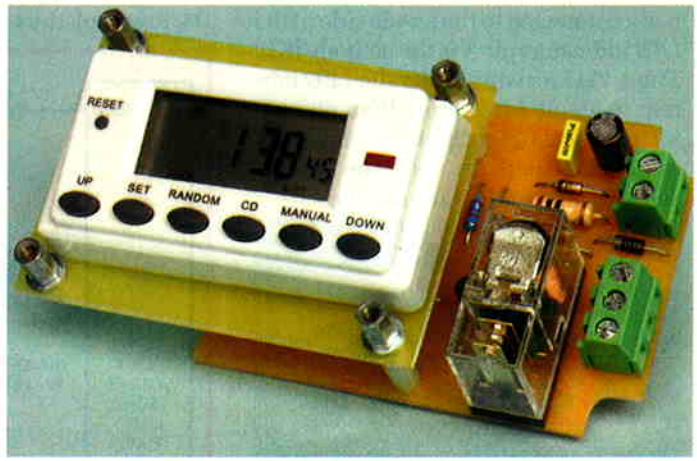
When the timer module output switches on (depending on the programs and functions set), pin 1 will go high. As diode D4 is now reverse-biased, current will flow through the 22kΩ resistor and switch Darlington transistor Q1 on, which pulls in the relay. Contacts "NO" and common now connect.

Diode D2 suppresses the voltage spike which occurs when the relay switches off, protecting Q1.

Back-up power from the on-board battery is useful if external power is disconnected (eg, through power failure) or if the unit is stored away when not in use. This allows the clock module to retain program set-up information.

The voltage divider network formed by the 8.2kΩ and 2.7kΩ resistors provide trickle charging through diode D3 and jumper switch S1 to the rechargeable battery. Diode D3 also stops the battery from discharging back into the circuit when external power is switched off.





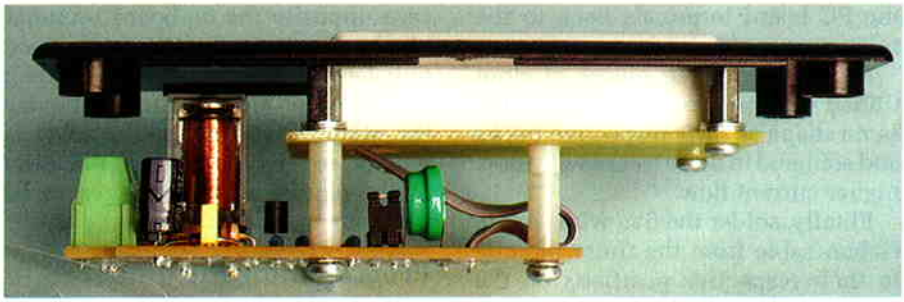
Jumper switch S1 isolates the battery from the circuit during assembly. Once all is complete and the construction is thoroughly checked, jumper switch S1 can be installed.

Note: do not connect external power to the circuit unless the back-up battery is installed and jumper switch S1 is in position.

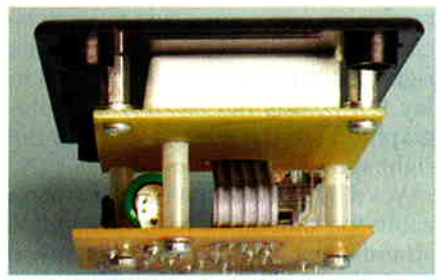
Construction

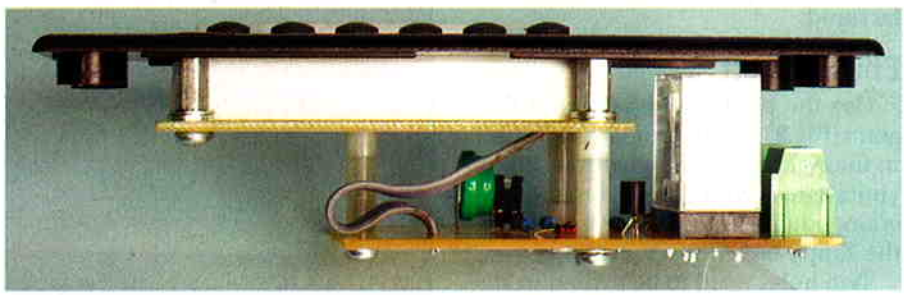
The project has two PC boards, only one of which has components on it. The second is used to hold the timer in place on/through a cutout in the front panel. It has a single large hole for the timer module cable to pass through.

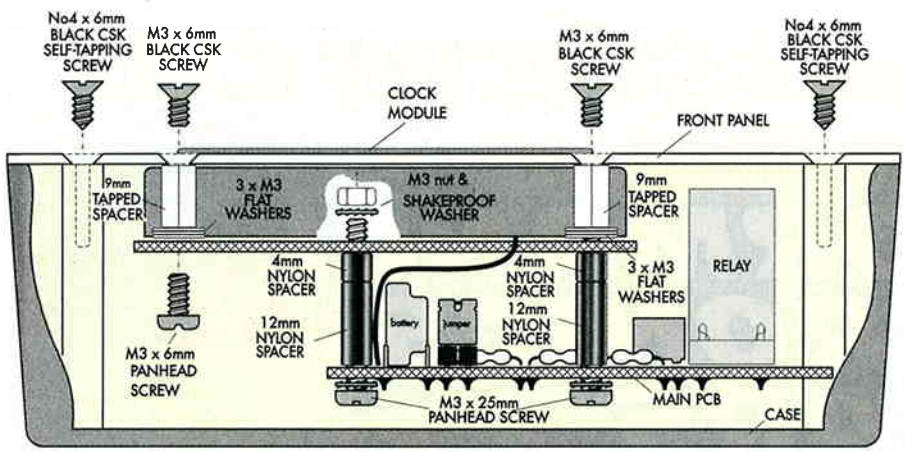
Luckily for you, in the DSE kit the cutout for the timer module and the mounting holes will already be punched. In fact, the front panel will be metal (the prototype was



Here are a few more shots showing how the boards go together. In these three, the front panel is attached, holding the timer module in place. The drawing below, Fig. 3, also shows how it all goes together.







built on the standard Zippy box ABS lid) – black powdercoated with white printing (similar to the prototype).

Final assembly is like a sandwich, with the main PC board on one side, the second PC board and the timer module in the middle and the case lid on the other side.The photographs and drawing (Fig.3) give a good idea of the construction method.

The timer module connects to the main PC board via a 5-way ribbon cable. The two PC boards are mounted together via three 25mm-long screws passing through two spacers (Nylon standoffs) – one 12mm and one 4mm. The main board actually overhangs the second board to allow room for the relay.

Two of the three 25mm screws pass through the second board and into M3 tapped 9mm standoffs.

These in turn are fixed to the front panel via countersunk 3mm black screws (the black to match the panel colour).

The opposite end of the second board also has 9mm M3 tapped spacers between it and the case lid but has 6mm M3 screws holding it down.

Parts list – 12V Digital Timer

1 Arlec 240V AC digital timer
1 main PC board, 78 x 57mm, code ZA0019
1 display PC board, 73 x 52mm, code ZA0020
1 UB3 Zippy Box (44 x 68 x 130mm)
1 front panel/case lid
1 10A SPDT relay
1 pin header (2-way)
1 jumper shunt (2-way)
4 M3 x 6mm csk screws (black)
4 6mm x No. 4 csk screws (black)
2 M3 x 6mm pan-head screws
3 M3 x 25mm pan-head screws
12 M3 flat washers
3 M3 shakeproof washers
3 4mm Nylon spacers
3 12mm Nylon spacers
4 M3 x 9mm tapped spacers
1 2-way terminal block
1 3-way terminal block

Semiconductors
2 1N4004 diodes (D1, D2)
2 1N4148 diodes (D3, D4)
1 15V 1W zener diode (ZD1)
1 MPSA14 Darlington transistor (Q1)

Capacitors
1 100µF 25V electrolytic
1 100nF MKT

Resistors (0.25W, 1%)
1 22kΩ 1 8.2kΩ 1 2.7kΩ
1 1.2kΩ
1 10Ω 1W

Assembly

There is nothing particularly tricky about assembling the PC board.

Of course, you need to watch out for electrolytic capacitor, diode, transistor and battery polarities (the latter must mount with its positive side (marked with a red "+") towards the middle of the board.

If in doubt as to the value of the resistors, use a digital multimeter to check them.

The last components to be fitted should be the relay, terminal blocks and header pin set (which forms S1).

Carefully check that you have the components in the right spots and, where appropriate, the right way around and that you haven't bridged over any tracks or left any components

You'll need to drill a couple of holes in one end of the case for the power wiring and switched (relay) wiring to emerge. The holes don't need to be this big – just enough to accommodate the wire you use.

unsoldered or improperly soldered.

We made mention before of the limited current capacity of the relay. The same comment applies to the PC board tracks. While these are much wider than other tracks, they are still not capable of high current.

If the intention is to use the timer to switch high currents, we'd be inclined to run a coat of solder over the entire tracks (three of them) from the PC board terminals back to the relay pins.

Even better, three pieces of stout tinned copper wire each bent to the same shape as their respective tracks and soldered to those tracks will allow higher current flow.

Finally, solder the five wires in the ribbon cable from the timer module to their respective positions on the PC board. Note that this cable is not marked in any way so you need to be careful that the right wires go to the right positions. The easiest way is to lay the boards out as in our photograph – then the wires end up in the right spots.

We'd advise not flexing the ribbon cable too much: its wires are single strands, not designed to be moved after the original timer was manufactured.

Finishing off

Use the photos and assembly diagram (Fig.3) to put the boards together in the right order and position. When yours agrees with our photos and diagram, you're almost ready to put it in the Zippy box. But not quite!

Two holes need to be drilled in the case opposite the on-board terminal blocks. In most cases, the holes need only be big enough for two wires each (supply one side, switched device the other). However, as the relay is a changeover type, your application might require all three wires to be used. It's up to you.

Programming the timer

In the kit, you will be supplied with the complete Arlec PC697 timer, complete with instructions. As the basic function of the timer hasn't changed, you program the timer in accordance with those instructions. There is little point in repeating the instructions here. **SC**

Where from, how much:

This project was designed by Dick Smith Electronics, who also retain the copyright.

A complete kit (Cat K-3582), including the Arlec Digital Timer and screened front panel, is available from Dick Smith Electronics stores and www.dse.com.au for $49.40

*Dick Smith Electronics kit department

From the publishers of SILICON CHIP

Our most ambitious title yet:

PERFORMANCE ELECTRONICS FOR CARS

Performance Electronics for Cars
From the publishers of SILICON CHIP
Intelligent turbo timer
TURBO BOOST & nitrous fuel controllers
How engine management works

NOT A REPRINT: More than 160 pages of new and exciting projects never published before – all designed to get top performance from your car.

FASCINATING ARTICLES: 7 chapters explaining your car – engine management, car electronics systems, etc

ADVANCED PROJECTS: You'll build controllers for turbo boost, nitrous, fuel injection and much more!

We explain the why as well as the how to!

Available direct from the Publisher ($22.50 inc postage):
Silicon Chip Publications, PO Box 139, Collaroy NSW 2097. Ph (02) 9939 3295; Fax (02) 9939 2648;
email silchip@siliconchip.com.au or via our website: www.siliconchip.com.au

PRODUCT SHOWCASE

Lab1: multimeter, power supply and soldering station in one

SA-based Wavecom Instruments have available the Velleman Lab1, a three-in-one unit which looks ideal for schools, laboratories or even the serious hobbyist.

On the left is a 3.5 digit LCD multimeter, offering 0.2-600V DC, 200 and 600V AC, 200uA to 10A, 200Ω to 2MΩ (full scale) resistance, diode, transistor and continuity testing, with data hold and buzzer. It is battery operated and fully isolated from the rest of the unit for both operator safety and isolation while testing. Test leads and a 9V battery are included.

In the centre is a DC power supply, with 3, 4.5, 6, 7.5, 9 & 12V switchable output at 1.5A continuous (2A peak). With very low ripple, it has LED power on and LED overload indication.

Finally, the unit houses a temperature-controlled soldering station with 150-450°C range, claimed to be lead-free soldering compatible. The 48W ceramic-element iron is low voltage (24V), again for safety of both users and devices being soldered. A spare iron element and tip cleaning sponge are included.

The supply and the soldering station each have separate, isolated power supplies.

The Lab1 has an introductory price of $299 including GST, which compares well with three separate equivalents. However, when you add the convenience of having all three in one handy unit, it represents very good value for money.

Contact:
Wavecom Instruments
257A Grange Road, Findon, SA 5023
Tel: (08) 8243 3500 **Fax:** (08) 8243 3501
Website: www.wavecom.com.au

New kit projects for kids

We all had to get our start in technology somewhere . . . and Jaycar have just released a new range of kits which will help kids get that start. Each contains a number of projects to make things that actually work and do things to keep that interest up!

There are eight kits in the range, each covering a different aspect of technology (and not just limited to electronics). All are priced at $19.95 each including GST.

The titles include Electricity, Inventions in Radio and Telecommunications, Magnetism, Lights Colours and Optics, Inventions in Rockets, Flight, Boats, and Vehicles. Some kits are suitable for children as young as five; others slightly older (oldest is eight years).

Each kit includes a book loaded with materials to stimulate young minds and all materials for the projects are supplied (with the exception of common household items such as sticky tape). Where power is required, they are all battery operated (naturally, batteries aren't included).

They're all available from Jaycar Electronics stores, most resellers and Jaycar Techstore online.

Contact:
Jaycar Electronics
PO Box 6424, Silverwater NSW 1811
Tel: (02) 9741 8555 **Fax:** (02) 9741 8500
Website: www.jaycar.com.au

17-inch LCD monitors are IP65 splashproof

Microgram Computers have available two models of 17-inch industrial LCD monitors, both of which are rated as "splashproof" – IP65 – totally protected against dust ingress and against low pressure water jets from any direction (limited ingress permitted). One model is also a touchscreen model.

The "VGA" monitors have a resolution of 1280 x 1024.

Because of their IP65 ratings, the monitors are ideal for use in exposed locations such as information kiosks, etc.

The touchscreen model has a recommended retail of $1399 (inc GST), while the standard screen sells for $990 (inc GST).

Microgram also have two smaller touch screen monitors, both of which operate from 12V DC. While not splashproof like their larger counterparts, these monitors are also idea for information services (indoors). The 8-inch model sells for $547.80, while the 7-inch is $470.00 (both inc GST).

Contact:
Microgram Computers
PO Box 225, Brookvale NSW 2100
Tel: (02) 9939 4377 **Fax:** (02) 9939 4376
Website: www.avcomm.com.au

STEPDOWN TRANSFORMERS
60VA to 3KVA encased toroids

Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fax (02) 9476-3231

DigiAir dB – the antenna installers' new best friend!

Most TV antenna installers or repairers have some form of field strength meter in their arsenal. The better ones give a readout, by channel, in dB or mV (or both). But they have usually been luggable, rather than portable. And their price tags have usually matched their size.

Av-Comm, the specialist satellite TV equipment supplier, has recently added the DigiAir dB to its range of test gear, complementing the satellite receiver installation gear.

Av-Comm's Gary Cratt said that the vast majority of installers of satellite gear also installed terrestrial TV antennas (and vice versa), so they would welcome this handy new product.

The DigiAir dB is small enough to fit in the palm of your hand but has a number of advanced features which will make siting and aiming an antenna much quicker and simpler than the old "point, hope and adjust" method. It is very sensitive and makes short work of differentiating between weak and strong signals.

Its backlit LCD screen can show the complete spectrum in one display, with one channel in high resolution or six channels simultaneously. A built-in rechargeable battery means that it is truly portable – a power supply and car charger is included.

The Digi-Air dB is Swedish-made but the model sold by Av-Comm is specifically made for Australian/NZ television standards and covers the full 47-862MHz spectrum. It sells for $599 including GST.

Contact:
Av-Comm
PO Box 225, Brookvale NSW 2100
Tel: (02) 9939 4377 **Fax:** (02) 9939 4376
Website: www.avcomm.com.au

Advanced home weather station from Ecowatch

Elsewhere in this issue we feature the "carchip" from Ecowatch. However, it was another product from the same company that made us sit up and take notice!

It's described as "the best home weather station ever" and offers home users, farmers, tourism operators and anyone else interested in the weather to not only take readings of all the parameters which make up the weather but actually forecast it.

The Vantage Pro2 has two parts – an in-field (outside) weather gathering unit and in inside terminal, complete with LCD screen.

The two units can be wired or wireless, with wireless transmission range up to 300m. Actually it can go much further than this with repeater units adding to the system if you wish.

The unit updates every 2.5 seconds with details of wind, rain, barometric presure, temperature, humidity and more.

These are available both instantly and over time for trends to emerge and forecasts made.

Contact:
Ecowatch
Unit 5, 17 Southfork Dve, Kilsyth Vic 3137
Tel: (03) 9761 7040 **Fax:** (03) 9761 7050
email: davis@ecowatch.com.au

Trusys serial to TCP/IP converters

If you have serial devices which you would like to monitor and/or control remotely via the net, the BF-430 and BF-450 TCP/IP to RS232/485 converters from Trusys could be just what you are looking for.

With a wide range of protocols supported, including TCP, IP, UDP, Telnet, ARP, DHCP, ICMP, PPPoE, HTTP, DDNS and SMTP and an equally broad range of operating systems (virtually all flavours of Windows plus Linux and UNIX), there is very little that cannot be controlled or monitored on the remote serial device.

Full network management is available via the web. They support TCP/UDP server/client mode and a there is a built-in HTTP server which enables easy set-up and remote management via any browser.

There are two models; the BF-430, which retails for $85.00 and the slightly larger and more expensive BF-450 (rrp $95.00) which even offers an I/O controller, alarm generation with email and SMS notification.

Applications include factory and hospital automation, access control and security, meter monitoring, CNC machine and PLC instrument control, time recording systems etc.

Features include a DHCP client, dynamic DNA, TCP/UDP server/client support, backup and restore configuration and auto negotiating 10/100Mbps Ethernet.

Power requirement is 10-30V DC @ 300mA. Size of the BF-430 is 67 x 93 x 22mm while the BF-450 is 81 x 103 x 30mm.

Contact:
Trusys
65 Mc Canns Rd, Mt Duneed, Vic 3216
Tel: 0428 28 2222 **Fax:** (03) 5264 1275
Website: www.trusys.com.au

Sanyo's NiMH batteries are pre-charged

Rechargeable Nickel Metal Hydride batteries normally wouldn't make a story – after all, they've been around for quite a few years now.

The new "eneloop" cells from Sanyo are a story: they're sold already charged, so they are ready for use straight out of the pack – just like standard Alkaline or dry cells.

In the past, NiMH cells haven't been sold charged, mainly due to economics but also because of self-discharge. Sanyo apparently have the first part beaten and have guaranteed that the cells will still be usable after a year of shelf life. They are claiming technological breakthroughs which give 85% capacity after 12 months. Their marketing also extols the known virtues of NiMHs – no memory effect, comparatively better energy characteristics than dry cells and of course, the fact that they can be recharged up to 1000 times.

Sanyo "eneloop" NiMH batteries are currently available in AA and AAA sizes, in various packs, from most battery retailers.

Sandisk MP3 player hits 10GB capacity

SanDisk has unveiled the world's largest capacity flash-based MP3 player, the 8GB Sansa e280 that boasts award-winning audio, photo viewing and video clip playback capabilities.

Priced at $US249.99 the e280 sports a microSD expansion slot allowing expansion to 10GB of music—or 2,500 songs—with an optional SanDisk 2GB microSD card, making it the largest capacity flash-based MP3 player on the market.

In conjunction with the rollout of the e280 and in preparation for the holiday season, SanDisk has lowered its prices on the entire Sansa e200 line of products, including the existing 2, 4 and 6GB models.

The dimensions of the Sansa e200 are 4.4cm wide x 8.9cm long x 1.3cm high.

Big, heavy knobs!

DIY amplifier component specialist, Design Build Listen has released a range of solid brass knobs to help DIY enthusiasts give the ultimate finish to their amplifier projects.

The knobs are machined from solid brass and are available in 30mm (~1.15") or 50mm (~2") diameters. The 50mm knob weighs in at a hefty 320g or nearly ¾lb in old money!

Both knobs are available with central inserts in either black or stainless steel. These knobs are designed to compliment Design Build Listens ezChassis pre-punched cabinets.

Contact:
design build listen Ltd
PO Box 5415, Dunedin, New Zealand
Tel/Fax: +64 3 477 3817
Website: www.designbuildlisten.com

Radio, Television & Hobbies: the COMPLETE archive on DVD

This remarkable collection of PDFs ***covers every issue*** of R & H, as it was known from the beginning (April 1939 – price sixpence!) right through to the final edition of R, TV & H in March 1965, before it disappeared forever with the change of name to EA.

For the first time ever, complete and in one handy DVD, every article and every issue is covered.

If you're an old timer (or even young timer!) into vintage radio, it doesn't get much more vintage than this. If you're a student of history, this archive gives an extraordinary insight into the amazing breakthroughs made in radio and electronics technology following the war years.

And speaking of the war years, R & H had some of the best propaganda imaginable! Even if you're just an electronics dabbler, there's something here to interest you.

- **Every issue individually archived, by month and year**
- **Complete with index for each year**
- **A must-have for everyone interested in electronics**

Please note: this archive is in PDF format on DVD for PC. Your computer will need a DVD-ROM or DVD-recorder (not a CD!) and Acrobat reader (free download) to enable you to view this archive. This DVD is NOT playable through a standard A/V-type DVD player.

ONLY $62.00 +$8.80 P&P

Exclusive to SILICON CHIP

HERE'S HOW TO ORDER YOUR COPY:

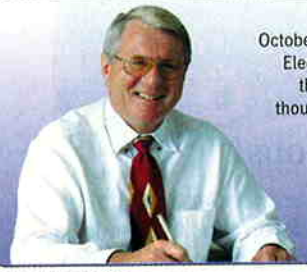
BY PHONE:* (02) 9939 3295 9-4 Mon-Fri
BY FAX:# (02) 9939 2648 24 Hours 7 Days
BY EMAIL:# silchip@siliconchip.com.au 24 Hours 7 Days
BY MAIL:# PO Box 139, Collaroy NSW 2097
BY INTERNET:^ siliconchip.com.au 24 Hours 7 Days

* Please have your credit card handy! # Don't forget to include your name, address, phone no and credit card details. ^ You will be prompted for required information

OCT' 06

ALTRONICS October Bargains!

★★★ HURRY, SALE ENDS OCTOBER 31st! ★★★



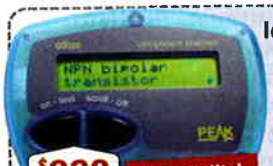
Melbourne One Year Anniversary

October marks 12 months since we opened out "One-Stop Electronics Shop" in Springvale, Victoria. The response thus far has been fantastic, and we wish to thank the thousands of customers who have dealt with us over the past year. **Look out next month for our massive end of year flyer sale!**

Jack O'Donnell - Managing Director

$20 OFF!
Orders over $100

ALTRONICS
Present this voucher to receive $20 off any order over the value of $100 in our Sydney and Melbourne stores. STRICTLY LIMITED TO IN-STORE CUSTOMERS ONLY!
Not to be used in conjunction with any other offer. Limited to one voucher per person per day. Only valid for orders over the value of $100. Personal shoppers in Sydney & Melbourne stores only, not available from dealers. Offer ends October 31st.



Identify & test components in SECONDS!

A MUST HAVE FOR SERVICE TECHNICIANS.

$220 Q 2100 RRP $275

Lab quality! A helpful time saving tool.

Semiconductor component tester. This compact, easy to use, component analyser is like having a library of electronic information at your fingertips! It saves you HOURS of looking up specifications. Great for R&D, engineers etc. Instantly identifies: • Diodes • Bipolar transistors • MOSFETS • JFETS • SCR's & Triacs • LEDS • Thyristors and more!

Subwoofer Sensation!

1000's SOLD ACROSS AUSTRALIA!

This fantastic subwoofer adds mind blowing realism to your home theatre or stereo system. Featuring a 180W 10 inch driver with built in amplifier producing a tiny 0.1% THD. A stunning frequency response of 35Hz-1KHz. • level control • crossover adjustment • phase reversal switch.

$250 C 5200 RRP $349

Inspect-A-Gadget Junior Magnifying Lamp

NO MORE EYE STRAIN!

Identify those tiny components, without straining your eyes. 300mm adjustable gooseneck. Great for stamp and coin collectors, electronics enthusiasts, technicians, model makers, seamstresses, jewellers and much more! Spare fluoro A 0969 $8.50

Features an ultra-bright fluorescent tube for extra crisp,clear view!

$49 A 0967 — 5 dioptre for ultra fine work

$49 A 0966 — 3 dioptre for general use.

Bargain for the home handyman, electronics enthusiast or student!

Compact & Stylish Rack Cases

IDEAL FOR AUDIO PROJECTS!

Superb quality finish for easy assembly. Tough powdercoated finish with anodised aluminium front panel. Rear panel is aluminium for easy customisation to suit your equipment.

$55 H 5032 2U RRP $69

$45 H 5031 1U RRP $55

Contact Free Digital Thermometer

SAVE 20%

...with laser guided beam!

Lightweight and easy to use, this "non contact" infra red thermometer provides accurate temp measurement of any object. Takes readings in dangerous places, or when equipment is operating. -30°C to 550°C.

As reviewed by Farming Ahead magazine, shown to have the greatest temperature accuracy out of 9 models!

$99 Q 1290 RRP $125

Underwater video down to 30m

This tiny camera can also see in the dark! Great for outdoor use, or even as an aquarium camera. **B&W only.**

Set up your own aquarium camera! Brilliant performer, even outdoors or water prone areas.

$150 S 9080 RRP $189

Activate 240V appliances via remote control - Up to 20m away!

Automate your home appliances at the touch of a button. Up to 5 mains sockets can be controlled from one remote allowing ON/OFF switching for up to 1000W of appliances per socket. Utilises RF signal for long distance communication.

PICK UP AN EXTRA MAINS SOCKET FOR $19.95! (A 0342)

$25 A 0340 RRP $29.95

FM Transmitter for MP3 Players

Transmits audio from your MP3 player to your car radio. Car accessory socket power adaptor included (also runs off 2 x AAA's). Easy to set up and use. 4 channels 88.3-88.7MHz FM band.

$25 X 0600 RRP $29.95

WHOPPING 25A Power Supply

3V to 15V @ 25 Amps With digital meters for precision adjustments!

Ideal for powering radio transceivers, car audio equipment, testing inverters or for any high current draw application. **Features:** • Regulated variable voltage • Overload & short circuit protection • Switchmode design for lightweight and reliability

$265 M 8224 RRP $309

Enhance Your Home Theatre Experience...

Store all your favourite movies, music & photos in one convenient box!

Simply by adding a hard drive to this stylish unit, you can create a totally portable multimedia solution for your home without the expense of a full hi-fi PC. It provides high quality audio and video playback for any files stored on the drive. Can be directly connected to your PC network! You could use it to store your entire DVD & CD collection! **Features:** • S-video component & composite video • Coaxial or optical audio • USB/LAN • **D 5520** 160gb HDD to suit $130

$269 D 5560 RRP $289

Suitable for most MPG formats, DivX, JPG, MP3 and more! Firmware upgrades also available.

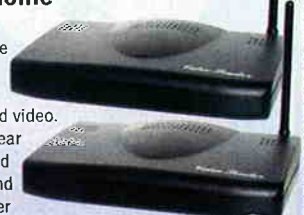
Replace up to 6 remote controls with just ONE!

Coffee table covered in remotes again? Tired of juggling a handful of remotes just to watch a movie? The A 0984 combines the functions of up to 6 of your current remotes into one! Incredibly easy to set up for your system with easy pre-programmed codes or infra-red learning function. **A professional grade remote control for the entry level home theatre system.**

With stylish blue backlit LCD screen!

$79 A 0984 RRP $99

Transmit audio & video in your home



The easy cable-free way to transmit audio and video. Sends clear vision and hi-fi sound to another location and even lets you control your audio equipment remotely.

$79 S 9360A RRP $94.95

Why buy 2 satellite/digital decoder boxes? Transmit it from your lounge room to anywhere in the house!

ALTRONICS ONE-STOP ELECTRONICS SHOP

3 Big Electronics Super-stores:

Perth WA: 174 Roe St Auburn NSW: 15 Short St Springvale VIC: 891 Princes Hwy

Order Hotline 1300 797 007

SOLDERING BONANZA SALE: Super Workbench Upgrades...

Professional Temperature Adjustable Soldering Station

An excellent multi purpose soldering iron. Perfect for service technicians, schools, engineers, R&D, production work etc.
Features: 45W • Japanese ceramic heating element for long life • Temp adjustable from 250° to 430°C

$99 T 2443S BARGAIN!

Includes **3 ULTRA LONG LIFE iron clad soldering** tips, over $30 in value, **FREE THIS MONTH!**
T 2421 0.4mm micro chisel, **T 2430** 0.8mm mini chisel
T 2432 3.2mm standard chisel

Whisk away solder fumes

Are you sick of soldering in a smoke filled workshop? Tired of coughing on soldering fumes when you're working on boards?
This compact fume extractor whisks away smoke & filters the air at the same time. All metal construction ensures it will last for YEARS!

SAVE 20% ON THIS SOLDERING ESSENTIAL!

$79 T 1295 RRP $99

Go Anywhere Gas Soldering!

Great for the handyman, auto electrician or enthusiast!
Work without mains power, anywhere, anytime. Available as an iron only (T 2600) or a great kit including blow torch, hot knife & hot air tips, solder, sponge and hard carry case (T2601). Powers on for up to 4 hours from a full tank of gas!

$79 T 2600 Iron RRP $99
$129 T 2601 Kit RRP $159

Save 20% On Handheld Soldering Irons

PRICED TO SUIT ANY BUDGET

GREAT VALUE!

Great for beginners, enthusiasts, home handymen or as a back up in the toolbox. All are supplied with a handy mini bench stand. Equipped with an iron clad, chrome plated tip for long life.

$16 T 2409 60W RRP $19.95
$13.50 T 2405 40W RRP $16.95
$10 T 2401 25W RRP $12.95

Micron Precision De-Solder Station

Desolders a 14 pin IC in less than 30 seconds, even on double sided PCB's!
A professional grade soldering tool, built tough to last a lifetime offering superb reliability, serviceability and performance, even when used every day! It offers adjustable temperature control and high speed continuous vacuum action for unbelievable performance, day in, day out. 300-450°C.
Sure to last a lifetime, even with the most demanding use!

$279 T 1260 RRP $379 $100 OFF!

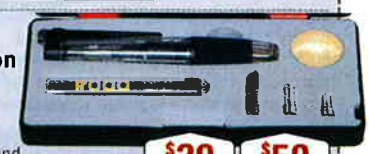
Reduce Heatshrink in an instant!

Fantastic pocket sized thermo-gun. Great for reducing heatshrink, removing adhesives, paint etc. With a flick of the trigger it instantly powers up to a whopping 650°C! Powered by a refillable cartridge (T 2475 $5.95).

Great for those quick jobs. Ultra compact design!

$25 T 2480 RRP $34.95

70W Gas Soldering Iron



Portable! Compact! Easy to use!
Don't fumble around in tight spots with a mains soldering iron, this tiny yet powerful gas iron will do the job in a jiffy. Great for auto-electricians, enthusiasts or home handypersons.
Kit Includes: • Plastic carry case • Blow torch tip • Hot air blower • Hot knife cutter • Solder • Sponge

$29 T 2595 Iron RRP $34.80
$50 T 2596 Kit RRP $60

Solder Store

Keep your solder roll handy all the time with this fantastic desk mountable reel. *Solder not included

$10 T 1300 RRP $13.95

Dry Solder Tip Cleaner

Keep tips in top nick!
Provides a quick easy way to remove excess flux, carbon and solder from your tip.

$10 T 1330 RRP $12.95

High Purity Butane

250ml can. Reduces 'gumming' and clogged gas filters.

$4.95 T 2450 HOT PRICE

Pro Grade Solder

Quality resin core solder. Lead/tin rolls 200gm. Unleaded rolls 250gm.

$9ea T 1075 0.5mm T 1078 0.8mm T 1080 1.0mm UNLEADED
$5ea T 1090 0.5mm T 1100 0.8mm T 1110 1.0mm LEADED

Solder Sucker

Great for the enthusiast or technician! Simple plunger operation sucks hot solder off PCB's in a flash. Anti-static construction, replaceable teflon tip.

$16 T 1246 RRP $19.95

Precision Impedance Meter

$199 Q 2005 RRP $235

Pro quality!
A must have for audio installers.
Measures transformer & speaker impedance accurately and easily. Applies a 30 second test tone (across 3 ranges) to any speaker or transformer circuit, returning an accurate impedance measurement on its jumbo "easy read" LCD screen. Suitable for both low impedance (typically 4 to 8 ohm systems) & 100V line systems. Requires 6 x AA batteries (S 4915 pk 2, $5.75ea).

Includes impact resistant cover PLUS a carry case!

600A True RMS AC/DC Clamp Meter

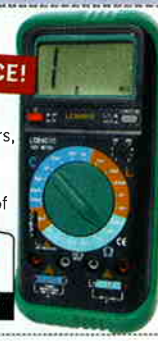
Accurately measures AC or DC current to a MASSIVE 600A! A professional quality unit with advanced features such as true RMS AC measurement, resistance, temperature, capacitance, zero & hold functions - All supplied with carry case & test leads. Max input 600V.

Great value for the student and professional alike! An essential for electrical tradespeople & auto electricians.

SAVE OVER 20%

$120 Q 0966 RRP $155

21 range Digital LCR Meter



HOT PRICE!

This super accurate LCR meter is perfect for developing audio crossovers, switchmode power supplies, resonant filters & RF circuits. Allows quick measurements of inductance, capacitance and resistance. Test leads, carry case and holster included.

$79 Q 1154 RRP $99

Keep your pool or fish tank balanced

Easy-check PH Meter
Why mess around with chemical testers or inaccurate litmus paper?
This compact pH meter provides an instant readout of water conditions without fuss!
Great for pool or fish tank owners. pH neutral buffering solution included.

25% OFF!

$50 Q 1295 RRP $69.95

Detect lethal AC voltages without contact

Non-contact pocket sized AC detector with LED flashlight. Essential for anyone operating with AC wiring. Lights up whenever it is near any AC source (100-600V @ 50-60Hz).

$20 Q 3002 RRP $25.95

A must have for electrical tradespeople!

19 Range Multimeter

Features a data hold function, transistor and diode test, 10A max current.

$14.95 Q 1121A BARGAIN!

Perfect student meter!

Express Order Hotlines

Phone: 1300 797 007 Fax: 1300 789 777 www.altronics.com.au

ALTRONICS
ONE-STOP ELECTRONICS SHOP

Your Electronics Specialist.

Secure Your Home On A Budget!

SAVE $50!

Mini PIR Door Minder & Alarm

$25 S 5320 RRP $29.95

Excellent unit for use in home, office, shops,etc. Works in 2 modes, as an entry/exit chime or as an alarm when triggered by the PIR movement sensor. 10m detection range. 9V operation.

Great value for money!

Micro-Bullet Cameras

SAVE UP TO $50

Compact, weatherproof (IP65) design. Great for monitoring outdoor areas. Superb quality image!. M 9243 plugpack to suit $18.

$195 S 9135A Colour RRP $245

$100 S 9085A B&W RRP $119

Install your own alarm system for under $150!

DON'T PAY A SECURITY COMPANY! Protect your home, family & possessions. Also great for small business.

This fantastic alarm system features unique "2 wire" technology which cuts installation time! (Just about anyone could install & program this system in HALF A DAY!) Everything you need to secure your home: Alarm panel, siren, strobe, 4 reed switches and 2 PIR sensors, plugpack, 50m of cable. **Features:** • Entry/exit delay • 4 zone monitoring • Tamper protection • Battery backup • User PIN code • PIRs use pulse count triggering to reduce false alarms • Panic function • Door chime • **S 5137 additional PIR's $39**

$149 S 5136 RRP $199

20m Camera Extension Lead

SAVE OVER 30%

$20 P 6713 RRP $29

Extends audio (RCA), video (BNC) and DC (2.1mm) power connections. All in one cabling solution

Reliable mains power anywhere, anytime!

Ideal for powering portable appliances on the road. These compact inverters allow you to get mains power from your car or 4wd's 12V battery!

Great for camping, farmers, mobile trades people & handypersons. Suitable for use with laptops, portable TV's, battery chargers, stereos etc. The 300W & 600W models are also great for small power tools such as drills, angle grinders and more! • Modified sine wave • Host of protection features • Soft start • High/low voltage shutdown • High surge wattage rating

$55 M 8072 12V 150W RRP $62.95

$89 M 8076 12V 300W RRP $99.95

$229 M 8084 12V 600W RRP $249

$229 M 8085 24V 600W RRP $249

GREAT VALUE FOR MONEY!

Professional Dual Tracking Power Supply

SAVE $70!

3 POWER SUPPLIES IN ONE 2 x 0-30V 3A

PLUS Auxiliary 1.5-6V 5A output!

$479 M 8226 RRP $549

Superb quality power supply for testing, repairing or R&D on complex equipment with split voltage rails. Built-in digital volt & current meters for precision accuracy. Supplies can operate independently, in series, or parallel. **Features:** • Overload & short circuit protected • Excellent regulation • Floating outputs

High Current Plugpacks

All supplied with 2.1mm DC jack.

$15 M 8909 5V 2.6A M 8925 9V 1.7A M 8934 12V 1.5A RRP $22.90

Super slimline case!

Regulated Bench Power Supply

SAVE OVER 25%

Delivering 3V, 4.5V, 6V, 7.5V, 9V and 12V at up to 1.5A. Great for voltage sensitive devices like video games, radios, scanners. Features short circuit and overload protection.

$29.50 M 8230 RRP $39.50

Compact Multi-Voltage Power Pack

20% OFF!

Up to a whopping 5A! Great for appliances with high current draw such as comms/IT equipment. Selectable voltages: 5, 7.5, 9, 12, 13.5, 15V. Output at 13.5 & 15V settings ≈3.8A. **Includes 6 appliance tips!**

$39 M 8987 RRP $49.95

Great Value Stereo Biema Amplifiers!

Extraordinary value for money! These amplifiers perform brilliantly, producing a smooth crisp sound with plenty of grunt when required. Each amplifier is precision assembled & built to last

Features • Whisper quiet operation • Fan forced cooling • 6.35mm and RCA inputs • Binding post, 6.35mm and industry standard speaker outputs • A host of protection features • 2 year warranty • 2 channel operation only

$270 A 4154 2 x 100W RRP $345

$335 A 4156 2 x 200W RRP $425

$395 A 4158 2 x 300W RRP $495

SAVE 20%

Need even more power? Our range of Biema amps go up to 1500W RMS! We also stock a wide range of high power stage speakers, great for upgrades or new systems!

Biema W110 - A 4154		Biema W220 - A 4156		Biema W330 - A 4158	
Power into 4Ω	2 x 170W	Power into 4Ω	2 x 350W	Power into 4Ω	2 x 450W
Power into 8Ω	2 x 100W	Power into 8Ω	2 x 200W	Power into 8Ω	2 x 300W

Speaker Drivers

Build your own speaker system or refurbish those old favourites!

HUGE 12" BASS DRIVER

SAVE $50

Sounds great in PA bins, DJ speakers & sub-woofers! Whopping 200W RMS from its huge 63mm voice coil, die cast framing for added rigidity. 8Ω.

$129 C 3212 RRP $179

Top Grade Hi-Fi Drivers

with large voice coils and magnets for superior performance!

A great choice for building into custom subwoofer cabinets for car, home theatre or hi-fi. Consult catalogue or website for full specs. All 8 ohm.

Save over 30%!

	RRP	2 for
C 3055 30W 6.5"	$29ea	$40
C 3060 60W 8"	$45ea	$60
C 3065 60W 10"	$65ea	$100
C 3070 100W 12"	$89ea	$140

Superb clarity hi-fi tweeters

$50/pr C 3005A RRP $37.50ea

High performance 50W ferro fluid 25mm silk dome tweeters. Consult catalogue or website for full specs. 8Ω. Magnetically shielded.

Compact 4" Twincones

High efficiency design with excellent midrange presence. Great for extension speakers, mini bookshelf systems etc. 15W 8Ω. **Add a pair of C 0815 ceiling grills to suit for just $7.60**

$25/pr C 0626 RRP $17.05ea

ALTRONICS ONE-STOP ELECTRONICS SHOP

No Risk 14 Day Money Back Guarantee

If you are dissatisfied with our goods for any reason, return to our premises within 14 days for a full refund (less transport costs). Returned items must be in NEW condition with all packaging and instructions (less transport costs).

Projects, Kits & More...

Handy Hardware Sale...

High Output Fans

Quality long life SUNON® fans. All sleeve bearing construction.

SAVE OVER 20%

SUNON Fans	RRP	Now
F 1045 60mm 12V	$16.75	$13
F 1050 80mm 12V	$16.75	$13
F 1047 60mm 24V	$16.75	$13
F 1025 80mm 24V	$16.75	$13
F 1060 120mm 24V	$28.90	$22

Heavy Duty Diecast Boxes

Great for projects requiring RF shielding or mechanical protection.

	RRP	2 for
H 0451 101x50x25	$8.65	$12
H 0453 121x66x38	$10.45	$15
H 0454 119x93x30	$14.90	$20
H 0455 193x112x61	$29.95	$40

High Quality Die-Cast Heatsinks

Ideal for building amplifiers or power supplies! Available with flat machined mounting surface or with 6mm mounting flange. Fins are powdercoated black. 300x75x46mm

20% OFF!

$22ea H 0542 Flanged RRP $27.50

$21ea H 0545 Flat RRP $26.50

Blank PCB - SAVE 20%

Great for prototyping or building your own custom projects. Copper clad fibreglass board.

STOCK UP AND SAVE! 300 x 300mm.

$17 H 0756 D/Side RRP $21.50

$15.50 H 0755 S/Side RRP $19.95

Keep cabling neat!

This spiral binding allows you to run neat cable looms. Great for wiring in cars, caravans etc.

$30/10m H 3812 RRP $3.50/m

Loom Tubing BARGAIN!

Split tubing for any project requiring a neat organised loom. 13mm inside diameter.

$16/10m H 3802 RRP $1.90/m

Create your own PCBs and save a fortune!

Includes aeration pump, tank and clips for suspending your PCB's in etchant

Get first class results for your one-off PCBs with this easy to use etchant tank. Ensures efficient, clean and safe etching. You can even speed up the process with a T 3202 tank heater **FREE THIS MONTH ONLY!**

FREE T 3202 PCB Tank Heater valued at $29. WHILE STOCKS LAST!

$79 T 3201S HOT PRICE!

Powdered Etchant

A clean, safe and easy to use Ammonium Persulphate etchant for mixing with hot water. Detailed instructions provided.

$10 H 0802 RRP $12.55

No fuss PCB press 'n peel film

AS EASY AS 1, 2, 3!

1. Photocopy/laser print
2. Iron onto your PCB
3. Etch your new board!

Pack of 5 A4 size sheets.

$25 H 0775 RRP $31.50

Handheld Television Pattern Generator Kit

(SC June '06)

ATTENTION: AV Installers, Service Technicians, Television Repair People!

NEW Only available at Altronics!

This compact, portable generator creates 9 commonly used test patterns which are easily displayed on any device with a composite video input, ie: projectors, plasma, lcd, CRT televisions etc. The standard patterns allow easy diagnosis of commonly found video image distortion problems. It fits right in your hand, is easy to build, and is powered by a 9V battery! Great for working on ceiling mounted projectors. Includes programmed PIC chip.

$129 K 2725 BARGAIN!

Class A Ultra Low Distortion Amp Module

(SC July 98)

A must have for serious audiophiles!

Highly accurate audio reproduction with minimal distortion (typically 0.0005% THD). Superb frequency response from an easy to build module. 15W RMS. **H 0545 heatsink to suit, on special this month for just $21!** Power supply module to suit K 5110 $26.95. KM5109 transformer $69.95.

$38 K 5109 RRP $45

High Tech Digital Thermostat (SC Aug '03)

Create temperature controlled circuits!

A digital thermometer kit designed to provide high/low alarms plus relay driving for thermostatic control. Great for air conditioning systems, computers, cellars etc. Reads -55° to 1200°C. 0.1°C resolution. Powered by 12V AC plugpack (M 9265 $14.50).

$89 K 6110 RRP $99.95

Remote Control Light Dimmer

PLUS touch plate for activating and adjusting lights. Remote control lighting adds a touch of class and convenience to your home. Remote to suit A 1009, $35. **Features:** • Adjustable dimming • 12V DC powered • Soft start for long globe life • Touch plate or remote control operation • Aluminium wallplate.

$55 K 6030 RRP $69.95

Don't get caught with a flat battery!

Ensures you have enough juice left in your battery to start your car.

This ingenious kit is great for people with caravans, recreational vehicles etc. It simply cuts power to portable appliances (eg: camping fridge) whenever battery voltage drops to a preset level (between 10.9-11.9V).

$19 K 4328 RRP $24.95

Sale Ends October 31st 2006

© Altronics 2006 Whilst all possible care is taken, Altronics takes no responsibility for any loss or damage howsoever caused, suffered by a reader with respect to any matter or thing referred to herein.

Resellers

WA	
ALBANY	Leading Edge Hi-Fi 98412077
ALBANY	J & M Electronics 98423404
ESPERANCE	Esperance Comm. 90713344
GERALDTON	ML Communications 99657555
JOONDALUP	Lantaztic 93010521
KELMSCOTT	Electronix Mart 94954433
NARROGIN	Great Southern Comm. 98814881
VIC	
BALLARAT	Wiltronics 53342513
BEACONSFIELD	Eclipse Security 97689007
BENDIGO	PCB Electronics 54444044
CASTLEMAINE	Star Electronics 54705433
CLAYTON	Rockby Electronics 95628559
CRANBOURNE	Lexicorp Electronics 59954277
CRESWICK	MB Radio Supplies 53452205
CROYDON	Truscotts Electronics 97233860
DANDENONG	Telecoms Pty Ltd 97933339
GEELONG	Academy TV 52481621
HORSHAM	Hobby N Tronix 53822319
LEONGATHA	Gardner Electronics 56622861
MELTON	Tandy 97431233
MILDURA	Benchmark Electronics 50210822
	Electronics R Us 50230762
NUNAWADING	Semtronics 98733555
PACKENHAM	Get Smart Hi-Fi & Repairs 59414886
PRESTON	Preston Electronics 94840191
SWAN HILL	Lateral Communications 50322322
WODONGA	Exact Electronics 60565746
WONTHAGGI	Raneye Pty Ltd 56724774
NSW	
BATHURST	Leading Edge 63323189
BROOKVALE	Brookvale Electrical 99384299
COBAR	Cobar Electronics 68362962
GUNNEDAH	Protronics 67422110
LITHGOW	Leading Edge 63523333
MIRANDA	Call Us Electronics 95427008
NEWCASTLE WEST	Henchman Products 49654444
NORTH RICHMOND	CPT 45714699
PENRITH	Penrith Light & Sound 47222223
PORT MACQUARIE	John Fettell Radio 65811341
SANS SOUCI	Marine Connect 95831710
SMITHFIELD	Chantronics 96097218
SYDNEY	David Reid Electronics 92671385
WATERLOO	Herkes Electrical 93193133
WINDANG	Mad Electronics 42977373
WOLLONGONG	Newtek Electronics 42271620
WYONG	Pro Disc Entertainment 43531100
QLD	
BRISBANE	Delsound PL 33978155
BOWEN HILLS	Prime Electronic Comp. 32527466
CAIRNS	Pentacom 40321710
CLONCURRY	Access Electronics 47422590
HERVEY BAY	Leading Edge 41283055
LONGREACH	Access Electronics 46580500
MACKAY	Stevens Electronics 49511723
MAROOCHYDORE	All Elect. Supplies 54436119
MARYBOROUGH	Leading Edge 41214559
MOUNT ISA	Outback Electronics 47433475
NOOSAVILLE	Noosaville Electronics 54740819
ROCKHAMPTON	Access Electronics 49221058
SOUTHPORT	Prime Electronic Comp. 55312599
TOOWOOMBA	Michaels Electronics 46329990
TOWNSVILLE	Solex 47754522
SA	
ADELAIDE	Aztronics 82126212
BRIGHTON	Force Electronics 83770512
BLAIR ATHOL	Aztronics 83496340
HOLDEN HILL	Force Electronics 82617088
MT. BARKER	Force Electronics 83911133
MURRAY BRIDGE	Force Electronics 85321433
WOODVILLE STH.	Force Electronics 83471188
TAS	
HOBART	Active Electronics 62310111
LAUNCESTON	Active Electronics 63347333
NEW ZEALAND	
CHRISTCHURCH	Global PC 33776086
RICCARTON	Global PC 33434475

Altronics One-Stop Electronic Shop

Phone 1300 797 007

Fax 1300 789 777

MAIL ORDERS C/- P.O. Box 8350 Perth Business Centre, W.A. 6849

Sydney: 15 Short St. Auburn NSW 2144

Perth: 174 Roe St. Perth WA 6000

Melbourne: 891 Princes Hwy. Springvale VIC 3171

Prices stated herein are only valid for the current month or until stocks run out. All prices include GST and exclude freight and insurance. See latest catalogue for freight rates.

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

Guy Burns is this month's winner of a Peak Atlas Test Instrument

Battery capacity tester

You'll appreciate this circuit if you've gathered a large collection of rechargeable batteries over the years and have no idea of their condition. This circuit will measure their capacity and display the results on a digital voltmeter (DVM).

The circuit (Fig.1) calculates ampere-hours (Ah) by measuring the time that it takes to discharge the battery under test to a preset cutout voltage, using a constant discharge current. Both the cutout voltage and discharge current are adjustable over a wide range.

The discharge current is controlled by applying a variable reference voltage to the non-inverting input (pin 10) of IC1c. This op amp functions as a voltage follower; it attempts to maintain the voltage at its inverting input (pin 9) – and hence the voltage across the 1Ω (or 0.1Ω) sense resistor – equal to the reference voltage.

Together with the Mosfet (Q1), this configuration yields an adjustable constant-current sink. Current ranges of 60-800mA and 0.6-8A are selectable using toggle switch S1, which simply selects between the 1Ω and 0.1Ω sense resistors.

Overall, the response of the circuit is non-linear, hence the need for a pot (VR1) with a log taper as part of the adjustable voltage reference network. Note also that the pot must be wired in reverse to what you might expect – so that turning it clockwise *decreases* the current setting.

The reset switch (S3) is pressed to initiate a measurement cycle. This applies a logic high level to the SET input (pin 6) of IC2a, a "D" type flipflop, driving its output (pin 3) high. This releases the RESET input of the 555 timer (IC3), which then begins to oscillate at about 0.7Hz, flashing the LED and clocking a 4020B 14-bit binary counter.

The eight most significant bits of the counter (Q7-Q14) are fed into IC5, an 8-bit multiplying digital-to-analog converter. The converter multiplies the counter's value with the reference current into its V_{REF} pin. The reference current varies as the discharge current varies, as both are set by VR2.

It thus follows that the D-A converter's output current is proportional to the discharge current multiplied by the digital count. As we've seen, the count is proportional to time, so the converter's output is proportional to amperes x time (ie, Ah).

Op amp IC1a is used to convert the output current to a voltage that directly corresponds to battery capacity, such that 1V = 1Ah. Trimpot VR3 allows the op amp's gain to be trimmed for calibration purposes.

During the discharge cycle, the battery voltage is monitored by IC1d, which is wired as a voltage comparator. When the terminal voltage drops below the cutout voltage (as set by VR2), the IC1d's output (pin 14) swings high, resetting the flipflop (IC2a). This terminates the battery discharge by pulling the gate of Q1 low via D1. It also resets IC3, which stops oscillating, freezing the count accumulated by IC4. The output of IC1a now sits at the measured "Ah" value until the reset switch is pressed again.

Clock frequency

The clock frequency is determined by the 1MΩ resistor and 1µF capacitor connected to pins 2 & 6 of the 555 timer. With the values given, the period is about 1.4 seconds, which results in a discharge time of about 6 hours (1.4 x 16,384 seconds). To increase the discharge time, increase the value of the capacitor and/or resistor.

Note that increasing the discharge time may necessitate an increase in the value of VR3 to allow for a higher Ah reading. Of course, it will also mean that the LED flashes at a slower rate!

To prepare the system for a discharge test, first connect a DVM between test point "B" and ground and adjust VR2 to the desired cutoff voltage. For an NiMh cell, this might be 1.0V, Li-ion 3.0V or SLA 11.0V (refer to the battery manufacturer's data for recommended cutoff voltage figures).

Next, set the discharge current to minimum before pressing the reset switch to start the test. Now connect your DVM to point "C" and adjust VR1 to obtain the desired discharge current.

Calibration

To calibrate the circuit, set it going as described above and note the time or start a stopwatch. Again, measure the voltage at point C to get the discharge current in amps. After about half an hour, monitor the voltage at point D. Note the time and the voltage reading when it suddenly jumps upwards. The counter increments every 64 clock pulses – about a minute and a half – so you will have to wait for the change.

Now calculate the actual Ah (amps x hours) and adjust VR3 until the voltage at point D is the same as the calculated value. Repeat the procedure a couple of times at half hourly intervals to check for linearity.

Note that the Ah reading may be incorrect if the discharge is not completed within the 6-hour period. The counter will recycle to zero and continue counting but there will not be any indication that this has occurred. Always check that the discharge current is set high enough to complete the discharge within the 6-hour period.

Guy Burns,
Ulverstone, Tas.

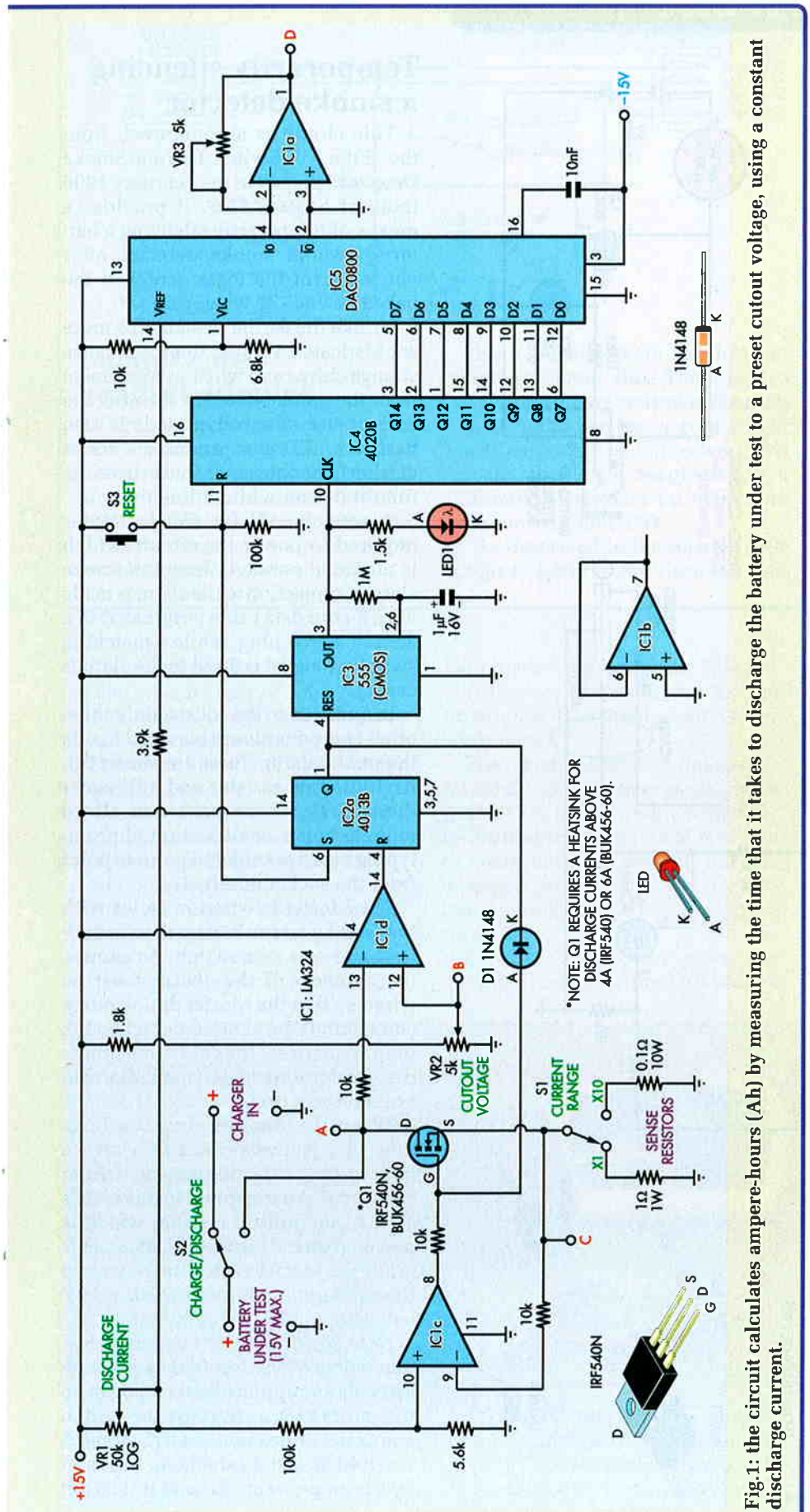


Fig.1: the circuit calculates ampere-hours (Ah) by measuring the time that it takes to discharge the battery under test to a preset cutout voltage, using a constant discharge current.

What can carchip do for you?

carchip, from Ecowatch, is simply amazing. Fitted in just minutes to most modern vehicles, **carchip** will record complete details of the car's operation which you can download and analyse at will. If you're a car enthusiast or do-it-yourselfer, **carchip** opens up a whole new range of diagnostic and performance options. If the vehicle's "check engine" light comes on, **carchip** will give you a "freeze-frame" engine sensor readout telling you when, where and why. It will even log accident details and what led to them!

See the carchip feature in this issue of SILICON CHIP

It is perfect for . . .

- **Fleet Managers**
- **Parents with Teen Drivers**
- **Do-It-Yourselfers**
- **Professional Mechanics**
- **Cost-Conscious Consumers**
- **Time-Pressured Commuters**
- **Environmentally-Aware Drivers**

. . . and so much more!

Call now for more information:

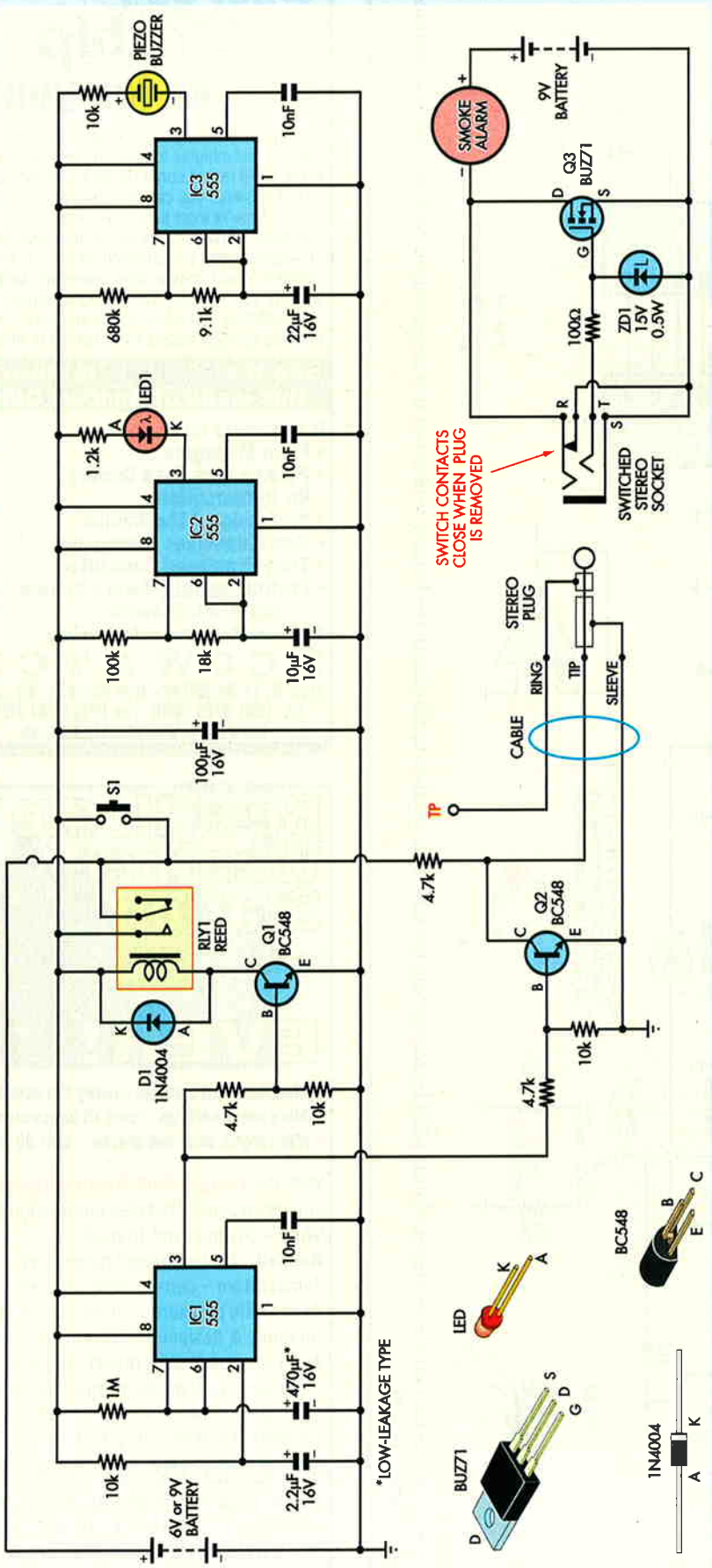
ECOWATCH
Unit 5, 17 Southfork Dve Kilsyth, Vic 3137
Tel: (03) 9761 7040 Fax (03) 9761 7050
www.davisinstruments.com.au

Best Home Weather Station . . . EVER!

- **More frequent updates – every 2.5 seconds!**
- **More alarm settings – over 70 parameters!**
- **More highs, lows and graphs – over 80 in all!**

With the **Vantage Pro2 Weather Station** you get incredibly detailed information on:
Wind – direction and strength
Rainfall – current, recent patterns etc.
Temperature – current, wind chill, etc.
Barometric pressure – current and trends
Humidity & dewpoint – current and 24 hrs
And your own local forecast. You'll be more accurate than the weather bureau! Available in wired or wireless models (wireless transmission up to 300m!)

ECOWATCH
Unit 5, 17 Southfork Dve Kilsyth, Vic 3137
Tel: (03) 9761 7040 Fax (03) 9761 7050
www.davisinstruments.com.au



Temporarily silencing a smoke detector

This circuit is an outgrowth from the "Fit a Kill Switch To Your Smoke Detector" project in the February 1996 issue of SILICON CHIP. It provides a means of temporarily silencing a battery-powered smoke detector after you've burnt the toast, scorched the baked beans – or whatever!

Unlike the earlier design, this more sophisticated version does not cause strange chirps and whistles to emanate from the smoke detector towards the end of the silenced period. It also flashes a LED and produces a series of short, unobtrusive tones from its inbuilt buzzer while it is active.

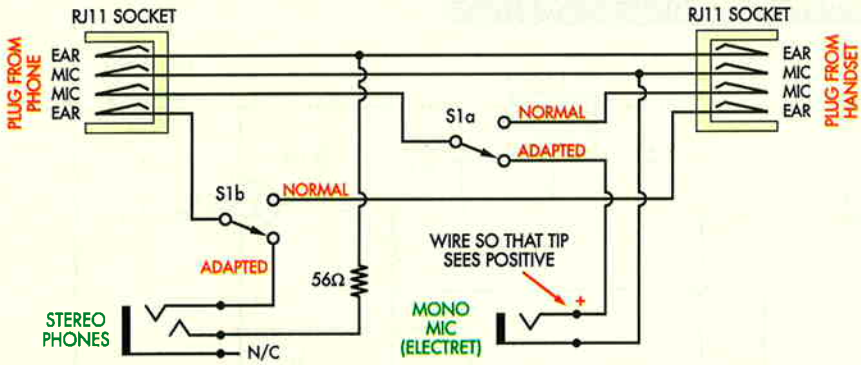
A separate 9V (or 6V) battery is required to power the circuit, which is mounted remotely from the smoke alarm. Connection to the alarm is made via a 3-core data cable terminated in a 3.5mm stereo plug, while a matching switched socket is fitted to the alarm's casing.

In addition to the socket, only three other components are installed inside the smoke alarm. These are Mosfet Q3, its 100Ω gate resistor and 15V zener diode ZD1. These parts can all be mounted on a small section of prototyping board or soldered point to point from the socket terminals.

The Mosfet is wired in series with the smoke alarm's negative battery lead and acts as a switch. As shown, the contacts of the socket must be wired so that the Mosfet drain-source connections are shorted out when the plug is removed, thus allowing immediate restoration of the smoke alarm to normal operation.

When the silencer circuit is inactive, the reed relay (RLY1) is off, so battery power is disconnected from the circuit. An exception to this is Q3's 4.7kΩ gate pull-up resistor, which is powered directly from the battery. This holds the Mosfet switch on, powering the smoke alarm from its on-board 9V battery.

Now consider what happens when the "silence" switch (S1) is pressed. This action applies battery power to the entire circuit through the switch contacts. At the same time, IC1 (which is wired as a monostable) is triggered by a brief pulse on its reset input (pin



Cheapskate's headset adapter

Here's a cheaper and easier method of making a telephone headset adapter than that described in the July 2002 edition of SILICON CHIP. All that's required is a cheap headset ($5 at Harvey Norman), a DPDT switch and a few connectors.

Each transducer in the headset measures about 40Ω. There is also an inline volume control measuring about 500Ω per leg, across which each earphone is connected. This means that each earpiece has a minimum resistance (at maximum volume) of about 37Ω.

As described in the SILICON CHIP project, 128Ω is the desirable impedance. This can be achieved by wiring the earphones in series and adding a 56Ω resistor. Although there is a reduction in maximum volume due to the resistor, this was easily accommodated by the author's telephone, which has an amplified audio output.

The headset does not have a connection between the earphones and the microphone, so no other modifications were required. Series connection of the earphones is achieved by not picking up the sleeve connection at the socket and connecting only across tip and ring.

As the author's telephone uses an electret microphone in its handpiece, no additional biasing circuitry is needed for the headset's microphone.

Brian Critchley,
Elanora Heights, NSW. ($30)

2). This initiates the 555's timing sequence, so its output (pin 3) immediately swings high, switching on Q1 and activating the relay.

A second transistor (Q2) wired to IC1's output also conducts, pulling Q3's gate low and switching it off. As a result, the smoke alarm is disconnected from its 9V battery and all of the noise ceases instantly!

When the relay is closed, an additional path exists from battery positive to the circuit's power rail – so that when the switch is released, the circuit keeps running. The circuit then continues to run for the duration of IC1's timing period (over 8 minutes).

The remaining two 555 timers (IC2 & IC3) are configured as astable multivibrators. IC2 is used exclusively to flash an indicator LED at a rate of about once per second. IC3 has a longer period, sounding a piezo buzzer briefly about once every 10.5 seconds.

Use a 5V reed relay when the circuit is powered from a 6V battery and a 12V version when powered from 9V. Because of the high impedance and low leakage of the Mosfet's gate, the silencer's battery can be expected to last almost its shelf life – assuming that you don't burn the toast too often!

Warning: (1) this circuit must not be used with mains-connected smoke detectors; (2) test your smoke detector and this silencer circuit regularly.

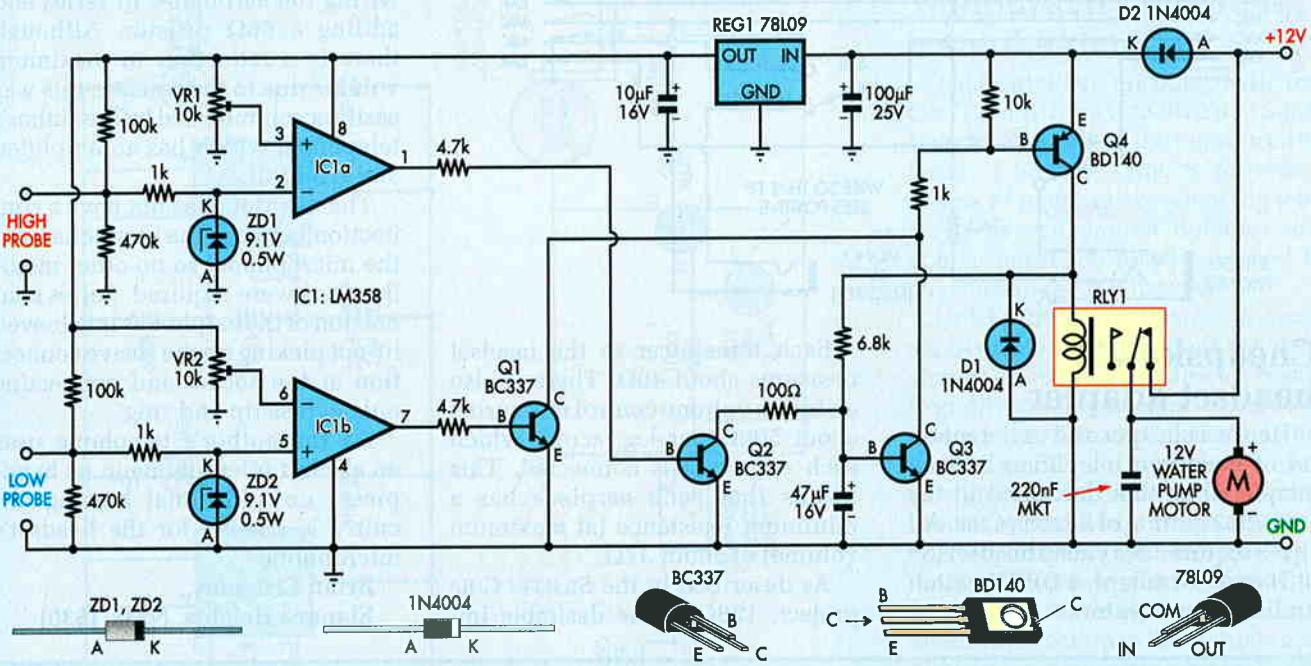
W. A. Fitzsimons,
Mount Eliza, Vic. ($40)

Contribute And Choose Your Prize

As you can see, we pay good money for each of the "Circuit Notebook" items published in SILICON CHIP. But now there are four more reasons to send in your circuit idea. Each month, the best contribution published will entitle the author to choose the prize: an LCR40 LCR meter, a DCA55 Semiconductor Component Analyser, an ESR60 Equivalent Series Resistance Analyser or an SCR100 Thyristor & Triac Analyser, with the compliments of Peak Electronic Design Ltd **www.peakelec.co.uk**

So now you have even more reasons to send that brilliant circuit in. Send it to SILICON CHIP and you could be a winner.

You can either email your idea to silicon@siliconchip.com.au or post it to PO Box 139, Collaroy, NSW 2097.



Reservoir pump controller

This circuit operates an automotive windscreen washer pump to fill a 20-litre drum from a 205-litre water reservoir. The drum is suspended above a drip line, which irrigates a vegetable garden.

Two stainless steel probes mounted in the drum act as sensors for the system. One probe is positioned at the high water mark, the other at about half-full. The pump power is switched by a 12V automotive relay (RLY1).

Two op amps (IC1a & IC1b) connected as voltage comparators form the basis of the circuit. Initially, assume a falling water level with the pump switched off.

When the water level exposes the lower probe, the non-inverting input (pin 5) of IC1b rises to about 7.4V. With trimpot VR2 correctly adjusted, this will be higher than the voltage on pin 6. The output (pin 7) therefore swings high, biasing Q1 into conduction. This in turn causes Q4 to conduct, switching on the relay and starting the pump.

In addition, when Q4 switches on it supplies base current to Q3 via a 6.8kΩ resistor. Initially, this current flows through the 47µF capacitor, but once its base-emitter voltage reaches about 0.6V, Q3 conducts. This action latches Q4 in the "on" state, as its base current can flow to ground via Q3 when Q1 stops conducting – which will occur when the rising water level reaches the low probe.

When the water level reaches the high probe, the voltage on the non-inverting input (pin 2) of IC1a decreases markedly due to the conductivity of the water. If trimpot VR1 is correctly adjusted, the output (pin 1) swings high, switching on Q2. This discharges the 47µF capacitor and robs Q3 of its base current, switching this transistor off. This in turn switches off Q4 and the relay.

The zener diodes and 1kΩ series resistors at the probe inputs protect the op amp's high impedance inputs from the effects of static discharge. The 47µF capacitor in parallel with the base-emitter junction of Q1 prevents the latching function from being activated when power is applied to the circuit.

The author's setup is powered from an old car battery charged from a 12V solar panel.

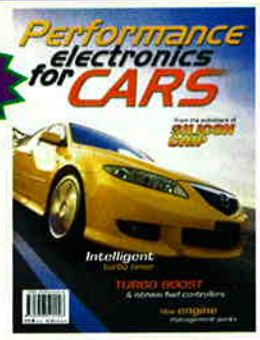
Peter Howarth,
Gunnedah, NSW. ($35)

Looking for real performance?

160 PAGES 23 CHAPTERS

- Learn how engine management systems work
- Build projects to control nitrous, fuel injection and turbo boost systems
- Switch devices on and off on the basis of signal frequency, temperature and voltage
- Build test instruments to check fuel injector duty cycle, fuel mixtures and brake & temperature

Mail order prices: Aust. $A22.50 (incl. GST & P&P); Overseas $A26.00 via airmail. Order by phoning (02) 9939 3295 & quoting your credit card number; or fax the details to (02) 9939 2648; or mail your order with cheque or credit card details to Silicon Chip Publications, PO Box 139, Collaroy, NSW 2097.



BY JULIAN EDGAR

Building a super bicycle light alternator

The traditional bicycle alternator or "dynamo" is not very effective. Here's how to turn a salvaged stepper motor into a high-power alternator for really effective lighting, even at low speed.

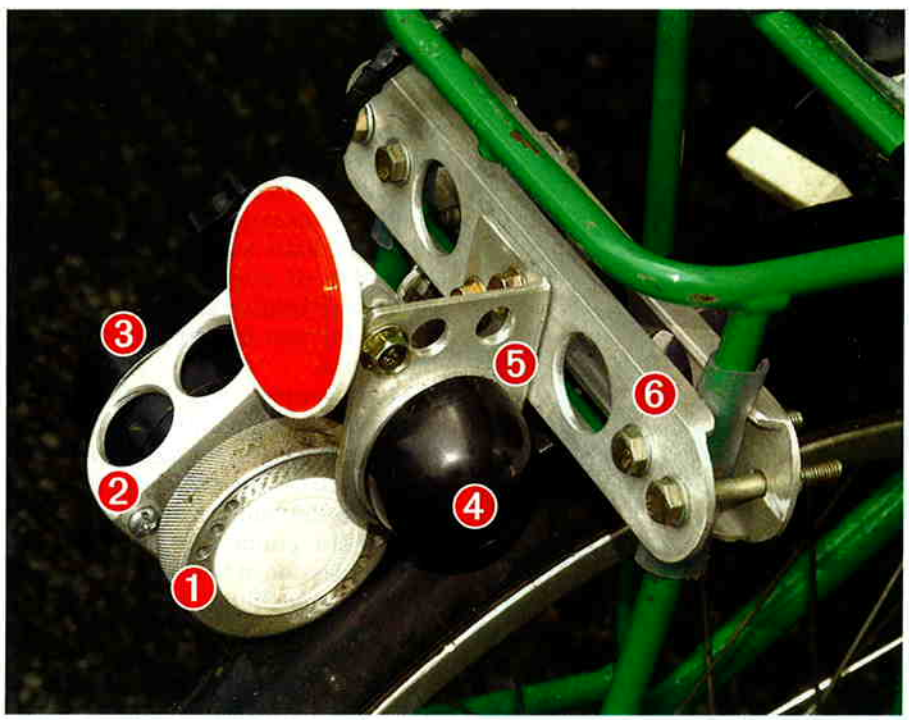
IN THE OLD DAYS, if you wanted lights on your bicycle, you headed off to the corner bike shop. There you equipped yourself with a "dynamo" (actually, an alternator) and front and rear lights, both of which used incandescent light bulbs.

These days, however, generator-powered lighting systems are out of fashion, replaced by flashing front and rear LEDs powered by standalone AA cells. Which is fine if you don't *really* want to see where you're going and you don't *really* want to be seen by other road users!

OK, that's not quite the case – there are some excellent high-intensity LED tail-lights available on the market. And as for seeing where you're going, if you're rich, miniature halogen headlights with their own rechargeable battery packs can be purchased.

These latter systems, some of which retail at $300 or more, provide excellent illumination but there's a downside – the battery pack needs to be frequently re-charged. In fact, if you ride for more than an hour at night, the battery may well have insufficient capacity to last the full length of the journey. Even Luxeon LED headlights and tail-lights (see the "Universal High-Energy LED Lighting System" in the April & May 2006 issues) are limited in lighting duration if you're away from a mains or car power source.

In short, if you want a lot of light over a long period, you must either carry a heavy battery pack or, alternatively, generate your own electricity as you ride along.



The main components of the author's bike alternator system are clearly shown in this photo: (1) knurled aluminium roller made from a video drum (the white centre cap is from the top of a vitamin jar); (2) alternator support frame; (3) stepper motor (used as an alternator); (4) cover over end of video drum bearing (the cover is the cap from a deodorant bottle); (5) bearing support and (6) bike support frame.

Generating power

A traditional bicycle "bottle" alternator uses an 8-pole circular permanent magnet that spins between two coils. Their power rating is generally around 3 watts at 6V.

In all designs that aren't electronically controlled, the output voltage increases with speed. As a result, the output is "governed" by a relatively high (eg, 14Ω) internal coil resistance to prevent the bulb's filament burning-out at high speed. In other words, go really fast and you're putting in lots more energy without getting any more out of the alternator.

A more expensive approach – one that isn't normally used in bicycle applications – is to use a stepper motor as an alternator. This approach has two main advantages: (1) a high output can be gained at low speeds without unduly compromising the output at higher speeds and (2) the total power output is much greater than can be

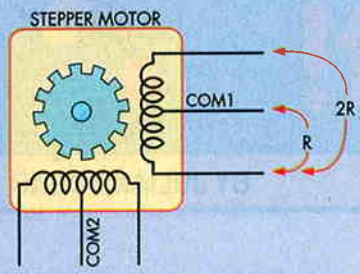


Fig.1: 6-wire stepper motors have internal wiring that looks like this. When quickly sorting through a batch of possible stepper motors, placing a LED directly across a pair of wires (eg, connections 1 and 2) and spinning the stepper by hand will give a quick and easy indication of its potential power output.

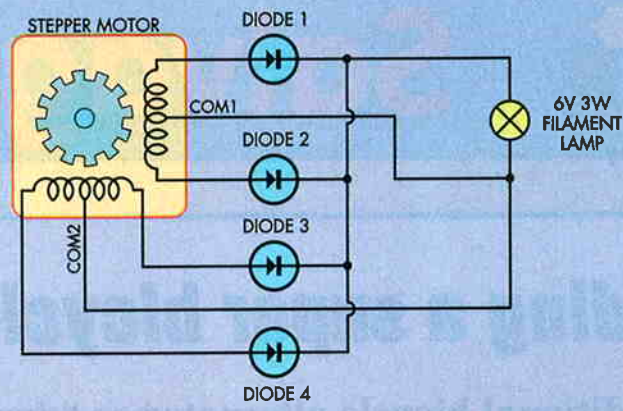


Fig.2: a further test of the alternator's output can be made by driving it with an electric power drill. As shown here, the alternators output is rectified and connected to a suitable load such as a 6V 3W incandescent bulb. The higher the output, the better but as a guide, the stepper shown on these pages developed 8.4V DC at 0.6A when rotated by the electric drill at a nominal 900 RPM.

achieved with a traditional bike dynamo.

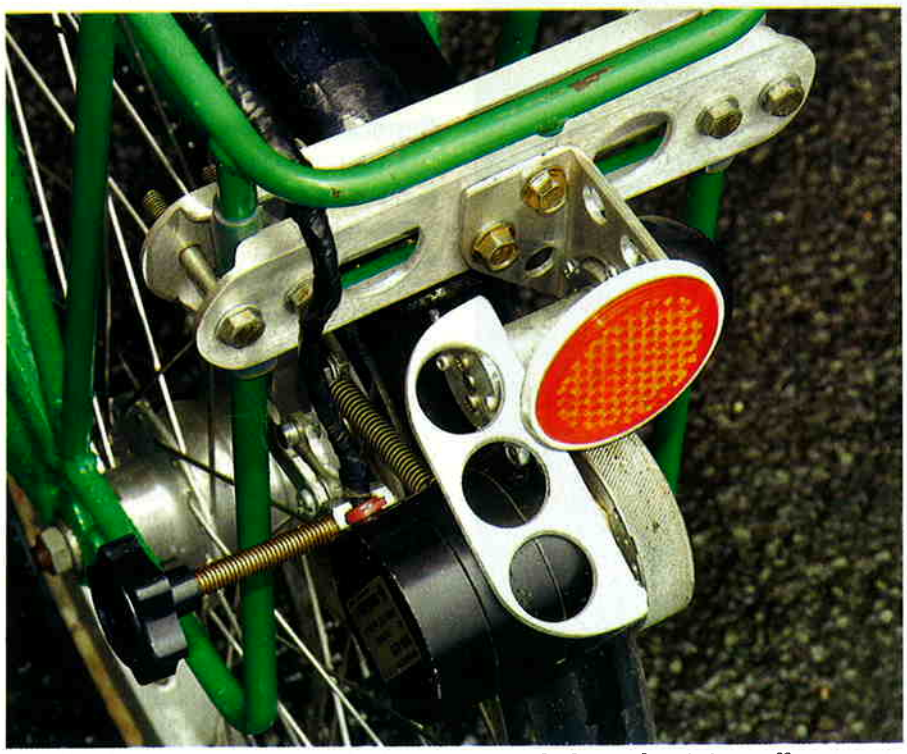
Another advantage is that if the stepper motor alternator is used to recharge a battery pack, its output voltage will remain relatively constant over a wide range of speeds.

Finally, while they may be expensive to buy new, suitably-sized stepper motors are available for nothing from a wide range of discarded goods, such as photocopiers, large printers and old electric typewriters. So if you can scrounge one from somewhere, you'll save heaps.

So how much output can be obtained from a stepper motor alternator on a bike? Well, on my machine – which is actually a 63-speed recumbent trike – I've measured an absolute maximum output of 54 watts! That's right – 54 watts or about 18 times the output from a normal bike alternator!

Even when charging a 12V battery pack, it's possible to achieve a continuous power output of 10 watts at normal road speeds – over three times the output of a conventional bike alternator!

So how do go about getting one working on your bike.



The brackets that locate the alternator were made from aluminium offcuts purchased for next to nothing from a scrap metal dealer. A large number of holes were drilled in these brackets to give a very light weight while still maintaining sufficient strength and rigidity.

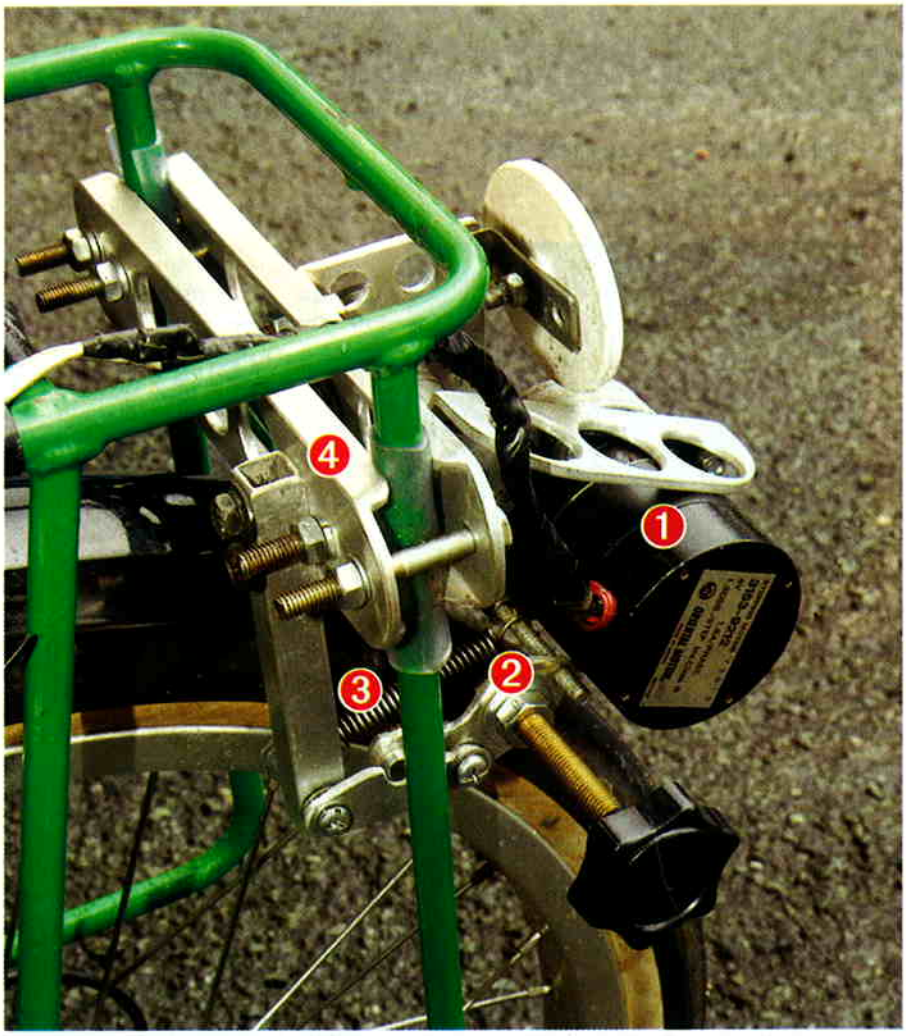
Selecting the stepper

Stepper motors often look much the same, so how do you pick the best one if you've got lots to choose from?

First, go for a stepper that's decently sized. For example, the one I use is 55mm in both length and diameter. This size of stepper normally has sealed ball bearings rather than plain bushes but you should pull it apart to make sure.

Most steppers will be 6-wire designs with two separate centre-tapped windings – see Fig.1. Use a multimeter to measure the resistances of the coils to determine which wires are which. That done, connect a high-intensity LED across one of the windings winding (eg, connections 1 & 2 in Fig.1) and spin the stepper by hand. The stepper you want will light the LED brightly, even with a slow shaft speed (no, you don't need a rectifier – the LED will still light on the AC voltage).

Next, short those two wires together. The stepper should be now much harder to turn, with a distinct "cogging" action.



Here's another view of the author's system: (1) stepper motor; (2) "over-centre" link to allow roller to be locked in lifted position; (3) spring to pull roller against tyre and (4) bike support frame.

Now measure the DC resistance between these same two wires. The stepper that's best suited will have the lowest winding resistance – eg, less than 5Ω.

Now for a final check. First, connect four 1N4004 diodes to the output windings as shown in Fig.2 and connect a load – eg, a normal 6V 3 watt bicycle headlight. That done, use an electric drill to spin the stepper motor (which is now an alternator) and measure the output voltage and current with the load in place. The higher the output, the better but as a guide, the stepper shown in the photos developed 8.4V DC at 0.6A when running a 6V 3 watt filament bulb and being rotated by the electric drill at a nominal 900 RPM.

Installing the Alternator

In order to drive the alternator from a bicycle tyre, you'll need to press-fit a knurled aluminium or steel roller that's about 30-60mm in diameter to the shaft of the stepper. That might sound easy but the reality is often quite different.

In my case, I have a metal-turning lathe and so the task of making the roller was straightforward (see the accompanying "Video Head Roller" panel). If you don't have a lathe, then you might need to approach a local engineering works to make one for you.

Note that it's imperative that the roller is both perfectly round and is concentric with the shaft. The diameter of the roller is also important – we'll come back to this in a moment.

Rather than take the traditional approach of the roller pushing against the sidewall of the tyre, I chose to run the roller against the (semi-slick) tread of the tyre. This allows the use of a larger diameter roller while still letting

Fig.3: the current achieved when charging a nominal 4.8V NiMh battery pack with a 6-wire stepper motor with these specifications: 4V, 1.8 ° per step, 1.8A per phase. The alternator uses a 63mm diameter knurled roller contacting the tread of a 20-inch slick tyre. Note the high output at very low road speeds – even when using the large diameter roller, 800mA charging is achieved at just 9km/h.

the roller run true. However, there is a problem with this approach. Most salvaged stepper motors have only a short length of protruding shaft. If you mount a wide roller on this, much of the roller isn't supported by the shaft and so the roller will have a tendency to wobble.

In my case, I chose to use a narrow roller that is better supported by the shaft but bears against only the centre of the tyre tread. This works very well, with no detectable slippage, even in wet conditions. However, if the bike is to be used in muddy conditions or has a treaded tyre, a smaller roller that bears against the tyre sidewall should be used.

The alternator/roller combination needs to be mounted so the assembly can pivot, so as to push the roller

Stationary Power Station

Another application for a converted stepper motor alternator is on an exercise bicycle. In this case, a small diameter roller should be used and by feeding the output into a suitable charger, you can recharge batteries while you exercise.

That's a lot more useful than just dissipating your energy into a friction brake!

Using The Luxeon High Energy Lighting System

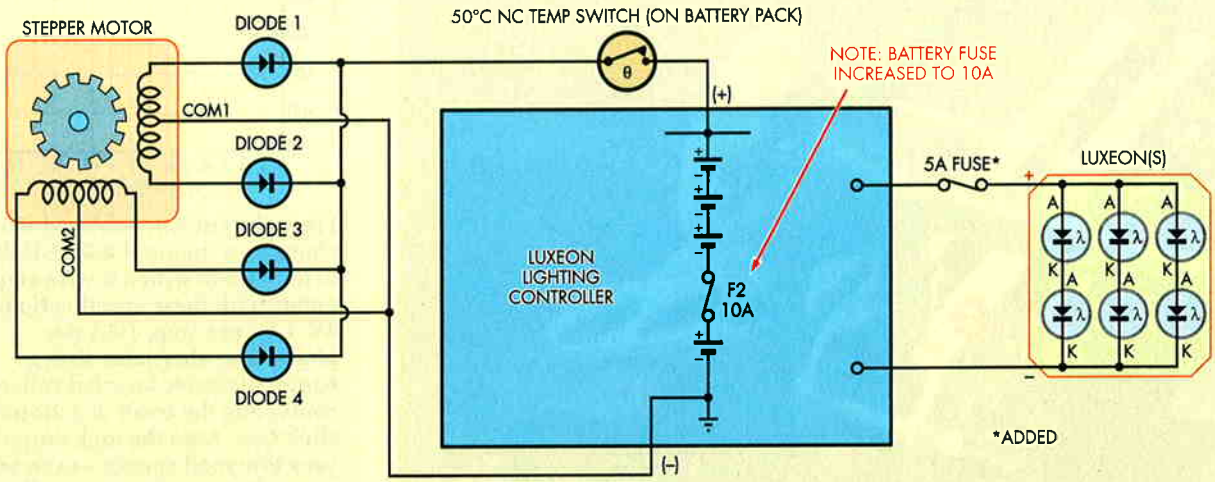


Fig.4: a very effective bike lighting system can be made by using the alternator to charge the battery in SILICON CHIP's Universal High Energy LED Lighting System. As shown here, the alternator is directly connected to the battery pack via a 50°C series temperature cut-out, the latter mounted on the battery pack. In addition, a 5A fuse is added in series with the Luxeon output and the battery fuse is upgraded from 5A to 10A.

The most best light sources for bike lighting systems are Luxeon LEDs. And in my opinion, the best control system for Luxeons is the Universal High-Energy LED Lighting System described in SILICON CHIP for April & May 2006.

In addition to efficiently operating LEDs up to 6 watts, the Universal High Energy LED Lighting System has specific bike light modes that alter flashing rates according to the ambient light levels.

However, you can't just connect the rectified output of the alternator to the charging socket of the Luxeon system to recharge the batteries. Why not? Well, since the no-load output of the alternator can be as high as 80V, this would destroy critical parts in the charging circuit. This occurs because once the input voltage exceeds 18.6V, charging automatically stops, and so the alternator sees a no-load condition and its output voltage skyrockets.

The best way to integrate the Luxeon system with the alternator is shown in Fig.4. As shown, the alternator's rectified output is *directly* connected to the battery pack through a 50°C series temperature cut-out (ie, the input charging circuit is bypassed). The temperature cut-out is mounted on the battery pack and prevents overcharging (the battery pack get hot if over-charged).

In addition, a 5A fuse is added in series with the Luxeon LEDs, while the existing 5A battery pack fuse (F2) is upgraded to 10A. These fuse changes prevent a scenario where when the Luxeon output is shorted, the battery fuse blows and the rest of the circuit sees 80V courtesy of the unloaded alternator.

In practice, the new charging cable from the alternator can be routed through the existing cable gland (there's just enough room for the two cables). Note that when using this revised configuration, the coloured LED will constantly show battery level – it won't change to indicate when alternator charging is occurring. If required, "top-up" charging of the battery pack can still be carried out using an external plugpack and in this situation, the charge LED will work as usual.

When charging the Luxeon system's NiMH battery pack, the alternator used by the author gave a measured output as shown in Fig.3. Note how as the road speed (and thus the alternator speed) increases, the rate of current increase begins to flatten out.

The trick is to gear the alternator so that there's still plenty of power available at low speeds but without the current output reaching a plateau early in the normal speed range. Another point to note is that the author's alternator was internally current limited to 1A. So in this case, when charging a battery pack at about 5V, the peak power obtainable from the alternator was 5 watts.

against the tyre. At its simplest, this requires only a few brackets and a normal door hinge but I chose to make a more elaborate mount.

As shown in the photos, I used the parts from a couple of video drum assemblies (salvaged from VCRs) to make a suitable assembly. First, one part of a video drum was used for the roller itself (see panel). That done, the main shaft support – which contains two widely spaced bearings – was reduced in diameter, as was the spinning head (note: all video drum components except the shaft and bearings are made from easily worked aluminium).

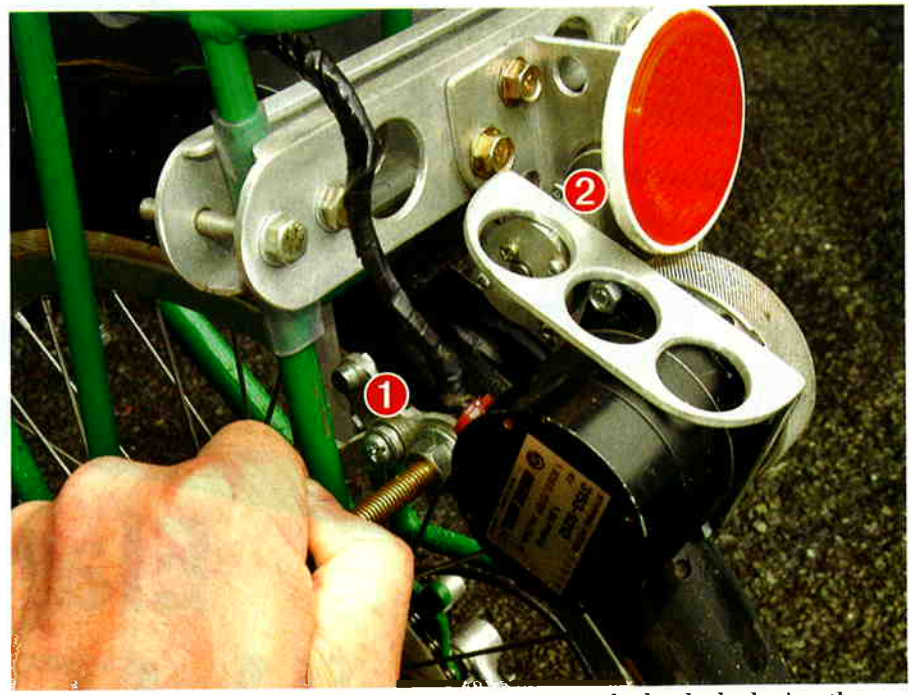
The stepper motor was attached to a cut-down spinning head via a bracket made from aluminium angle. The other part of the drum assembly, comprising the precision sealed ball

bearings and support, was attached to another aluminium bracket which in turn was bolted to a plate. This plate was then attached to the cycle carrier (note: the aluminium plates and angle brackets were drilled for lightness).

The video drum shaft and it bearings form the pivot on which the stepper motor/roller assembly rotates. This arrangement allows the roller to be pressed against the tyre while rigidly keeping the stepper motor shaft in parallel with the wheel axle.

Because the roller has a relatively large diameter, it doesn't need to be pushed hard against the tyre. A light spring will do the job, without an appreciable tyre deflection - and without the frictional losses that would otherwise result. (Note: because the stepper has a high output at low speeds, a small roller is not needed).

I also added an "over-centre" linkage in parallel with the spring which allows the alternator to be held captive in a lifted position if required.



When the over-centre lever (1) is released by turning the knob clockwise, the alternator/roller assembly pivots so that the roller contacts the tyre and is held there by a spring. The pivot is formed from a cut-down video drum assembly (2) that uses high quality ball bearings and a precision shaft. Note that a strong spring is not required as the large diameter knurled roller grips the slick tyre quite well.

Roller diameters

It is not just the characteristics of the stepper motor and the load that determine the electrical output from the stepper – it also depends on how fast the alternator turns.

In practice, the alternator speed is determined by tyre diameter, the drive roller diameter and how fast you ride. This latter point is often forgotten, but if you seldom exceed 10km/h, the gearing of the alternator will need to be quite different than if you frequently ride at 25km/h.

An alternator subjected to a load will have an output current that initially rises with speed and then levels off as the speed rises further. If the alternator is geared too high, the output current will limit early. This is bad because you'll be pedalling hard but getting no more out of the alternator.

On the other hand, if the alternator is geared too low, the electrical output will always be less than it could otherwise be.

Because the optimal alternator gearing depends on the load, the characteristics of the alternator and how fast you ride, the best approach is to try some different diameter rollers. The first roller that I made was 33mm in diameter. This gave excellent electrical output but the pedalling effort (even with no current draw) was relatively high (this "parasitic" load is due to internal hysteresis losses).

Using this roller on a 20-inch tyre gave an output of 12.7V and 0.8A when pedalling at 15km/h. This output was used to charge a 9.6V nicad battery pack. At over 10 watts output, there was power to spare, so I decided to try a larger 63mm diameter roller to slow the alternator and decrease the parasitic losses. This new roller reduced the pedalling effort and the electrical power output remains quite respectable.

Conclusion

It's not a five minute job but with a little time and patience, a salvaged stepper motor can be turned into a very effective high-power bike lighting alternator. SC

Using A Video Drum As A Roller

As described in *Salvage It!* for December 2005, the drum assemblies from VCRs are worthwhile salvaging. In fact, one can be used to make the roller that drives the bike alternator.

When you pull the video drum assembly apart, you'll find a hardened steel shaft that runs on sealed ball bearings. At one end of the shaft is a brass collar that is a push-fit on the shaft. Bolted to the collar is the part of the drum that spins. This comprises a 61mm diameter 12mm-wide aluminium disc.

The shaft of the video drum is a little smaller in diameter than the shaft of most medium-sized stepper motors. So if the brass collar is removed (easily done by using a vice to support the collar and tapping the shaft with a hammer), it can be carefully drilled-out to become a push-fit on the shaft of the stepper.

If the hole in the brass collar ends up a fraction too large to be a genuine push-fit, squeeze the shaft of the stepper in the hardened steel jaws of a vice. This will raise corrugations in the metal which will then grip the collar quite well. You can then apply some Loctite for additional security.

The drive surface of the aluminium disc can be knurled in a lathe (or have lateral striations cut across it with a file or hacksaw) and then bolted to the brass collar.

by
Poul Kirk*

Elan Audio's "MERLIN" Broadcast Quality Mixer

...ideal for training or semi-pro applications

Australian company Elan Audio has released a studio mixer with broadcast-quality specs, designed for applications such as school/college media training or even community radio station production. Elan have put together a comprehensive guide to the equipment and techniques required for this growing special-interest area.

Media Training is becoming a very important part of general education, as it helps students develop valuable skills in self-expression and the ability to present these to an audience. Many schools and colleges are now installing quite sophisticated media centres to assist with this training.

Indeed, some schools and colleges, especially those which have courses in the field, have studios and equipment which allows very professional video and audio production.

The presentation skills acquired by students from a Media Training Course will be extremely valuable and useful in a wide variety of future careers, whether that be as a professional radio journalist or presenter, or to simply call in these skills in sales and marketing, corporate management, or even choose a career where public speaking is essential – such as a politician!

Audio and video editing vs. music recording

As the saying goes, there are different strokes for different folks. Here we are most interested in the equipment and techniques used for sound recording and more specifically, recording of interviews, audio editing and radio-type presentation.

Video recording and editing requires a different set of equipment (although the audio component might share some of the equipment we are looking at here). Recording of music, whether groups or soloists, is yet another specialised area which requires yet another type of equipment and skills. In fact, music recording is best described as "Audio Engineering" – somewhat outside the scope of what we are describing here.

The radio broadcast training studio

The audio mixer or audio control panel is the central and most important piece of equipment in a radio broadcast studio, whether it is used for professional or community broadcasting or for Media Training

Broadcast (on-air) mixers are highly developed and specialised units which at first glance, seem rather simple and basic when compared to, say, a stage or PA (public address) mixer.

These usually feature a multitude of control knobs and switches but in fact lack the essential standard features of on-air mixers, making these unsuitable for use in

A typical "Merlin" application: a community radio station studio. Typically, dollars are short and so is equipment – but with the equipment shown here (and detailed in this feature) a community radio station can mix it with the big boys!

radio broadcasting.

Broadcast on-air mixers are designed to be easy to operate, have very good audio performance and benign overload characteristics able to handle accidental excessive audio levels. In fact, they are quite complex devices.

Let's have a look at some of the essential features on on-air mixers:

- *Silent channel on-off and cue switching*
- *Selectable monitor facility*
- *Automatic monitor mute with microphone on*
- *On-air light relay contacts closing with microphone on*
- *Accurate and easy-to-read audio level metering*
- *Overload and phase fault indicators*
- *Cue loudspeaker and cue level metering*
- *Announcers headphone output with split cue function*
- *Guests headphone output*
- *Manual monitor "dim" or mute*
- *Phase check switches*

And that's just the mixer! In a typical small radio broadcast training studio, you will also find:

- *At least two broadcast quality microphones*
- *A microphone boom arm for presenter's microphone*
- *A microphone table stand (for guest microphone)*
- *Microphone pop guards (desirable)*
- *Two pairs of good quality headphones*
- *A high quality monitor system (amplifier and loudspeakers)*
- *Two commercial CD players*
- *Audio "spot delivery" equipment*

That's the bare bones training studio. Desirable additional equipment might include:

- *Audio recording equipment*
- *Audio processor*
- *On-Air light*

Equipment details

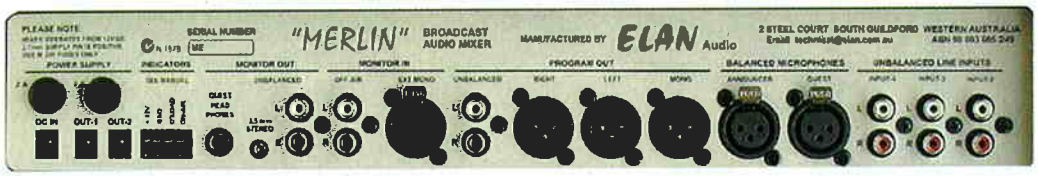
The Elan Audio "MERLIN" is designed specifically for use as a Media Training Mixer and is the ideal choice for a basic high school or college media training studio or for use in a community radio station, where it can also be used for basic production and outside broadcasts

With full broadcast performance specifications, this mixer operates exactly like a full-sized radio broadcast station "on-air" mixer, making the transition from a training studio to a radio station broadcast studio very easy for the student. As a bonus, it's as easy to set up as a typical hifi system.

Broadcast-quality microphones

There is no point training with, or broadcasting with, "toy" microphones. The quality of microphones must be acceptable for radio broadcasting and ideally (though not absolutely essential) the presenter and guest microphones should be identical.

- *Cheapest acceptable types are the AKG D770 II and D880 M types of dynamic microphones. Considerably better (but more expensive) is the AKG C1000 S Electret Condenser Microphone.*



The rear panel of the "Merlin" mixer is easy to understand, even for the novice trainee.

Microphone boom arm

An articulated boom arm is required for the presenter's microphone to allow easy adjustment and keep the area in front of the mixer clear. A second boom arm for the guest microphone would be nice but most choose a table-mount stand.

- *Suitable types include the K&M 23850, and K&M 23855 Table Mounting Flange*

Microphone pop guards

Microphone pop guards are much more effective in preventing the troublesome popping sounds caused by inexperienced presenters pronouncing "plosive" words than "foam rubber socks". They're also more hygienic than socks which can and do become a health hazard. In fact, socks are better used for wind noise reduction in outside broadcasts – and most presenters these days carry their own, just in case!

Experienced presenters, trained in correct microphone technique, should be able to use a microphone not fitted with a pop guard or foam rubber sock. "Microphone technique 101" should always include a lesson on NOT blowing into the microphone to check if it is working!

For training purposes, we suggest student be taught to use microphones without pop guards or socks.

Quality Headphones

Two pairs of medium quality headphones should be available for use in the studio. Once again, for health and personal reasons, presenters usually supply their own headphones. In this case, they need to be checked for suitability for the system and, more importantly, the correct connectors!

- *Cheapest acceptable type are the AKG K44.*

High quality monitor system

The importance of a high quality monitor system cannot be overstated. It allows students to accurately judge the audio quality of the project being worked on.

It is virtually impossible to accurately judge audio quality using ordinary "computer-type" speakers and even the best headphones available can be misleading if used for quality monitoring.

Good quality hifi equipment may be suitable if the budget is restricted. Otherwise, we suggest the following setup for guaranteed good results.

- *Altec Lansing AL-MX 5021 Active Speaker System consisting of one subwoofer and two satellite speakers*
- *Elan Audio RMA-01 monitor amplifier and one pair of Energy Connoisseur C3 bookshelf speakers*
- *Elan Audio RMA-01 monitor amplifier, Athena ASP-4000 subwoofer and 2 W-15 satellite speakers*

Commercial CD Players

We recommend that only commercial or professional CD players be considered. DVD players *can* play CD's but are virtually unmanageable, suffering from a very long loading time and are practically impossible to cue to the start of a track. In addition, the audio quality from most is not particularly good.

Moderately-priced hifi CD players are becoming difficult to obtain. Audio quality is generally good but they are also difficult to cue to the start of a track and will run into the next track if not stopped. Many "hifi" CD players cannot handle MP3 discs – an essential element in both training or community studios as many adverts, promos, stings and other audio may be supplied in MP3 format.

The difference between hifi-type and commercial CD Players is that the latter will automatically cue to the start of a selected track, start on command and stop at the end of a track. They also offer excellent sound quality and a number of other practical features including wired remote control start and certain practical programming features.

- *The DENON DN-C615 entry-level commercial CD player plays MP3 as well as CDs and is a perfect match to the "MERLIN" Mixer.*
- *Similarly, the DENON DN-C635 intermediate-level commercial CD Player plays MP3 and has a spin-dial track selector*

Audio "spot delivery" equipment

All commercial and community radio broadcasting involves the delivery to air of pre-recorded "spots" such as messages, commercials and sponsorship announcements. This should be simulated and form part of the training. Several delivery options exist: Mini Disk, Flash Card Player, CD Player and Personal Computer are the main ones.

Mini Disk suffers from a number of disadvantages, particularly that of being fragile and difficult to handle. Fortunately, it is a vanishing format; unfortunately it is still used by a number of community broadcasters.

Flash Card Players, such as the EDIROL-R1, and the more professional Marantz PMD 660 or rack-mounting PMD 570 can be used in place of Mini Disk and are less fragile and easier to handle or manage.

Although all Flash Card recorders feature a built-In microphone (or two in the case of the Edirol), a high-quality external microphone (or in some cases two), will produce much better results. Not only that, a radio station's ID or "flag" can be mounted on the microphone and if the interviewee is also being filmed, offers the chance for totally free station publicity (it's very hard for TV stations to edit out moving microphone flags!).

A commercial CD Player can, of course, also be used for "spot" delivery with the required material burnt onto a CD.

Best, most convenient and the most commonly used method these days, is a stand-alone personal computer or, as is common for virtually all commercial broadcasters, a networked, computer-based audio delivery system, loaded with suitable software and of course the required audio material.

The stand-alone PC together with the "MERLIN" Mixer, can also be used to produce and edit "spots" which in itself gives valuable training.

The PC can also be used to deliver recorded music tracks but for the purposes of Media Training, this is just too easy and not likely to help the student develop broadcast presentation skills!

Hum and noise

Hum and other electrical noise problems are often experienced when connecting PCs to audio mixers. Good wiring techniques, paying particular attention to earth loops, are essential. Even then, sometimes "heavy duty" help is needed.

Elan Audio has developed a hum reducer, the MIM-01, designed to connect between the PC and the "MERLIN" Mixer to eradicate or substantially reduce this problem.

Desirable Additional Equipment

A recording of the output from the mixer is necessary to allow both the teacher and student to critically evaluate the quality of student performance, presentation, and progress.

A cassette deck is usually satisfactory for this, provided the recording is to be used purely for evaluation or examination purposes. Compact audio cassettes are

cheap enough to keep as permanent records. However, if the recording is to be used for public presentation or radio broadcasting, a professional "Flash Card Recorder" such as the Edirol R-1 or Marantz PMD-660, or indeed a personal computer (student's own laptop?), is a better choice.

Professional flash card recorders operated at 44.1kHz, 16-bit linear sampling, (the same as standard CD-quality recordings). These recordings can be transferred to the "spot" delivery PC via USB for editing and cleanup, and then burnt to CD for possible later broadcast or auditioning and examining by the media teacher.

Editing and signal cleanup

Editing and cleanup may be undesirable for program material recorded for examination but is very practical, even essential, for material recorded for later broadcasting

An Audio Processor is an automatic level controller, normally connected between a broadcast studio and a transmission system to prevent over-modulation; or between an audio mixer and recording equipment to keep audio levels from becoming excessive.This often causes overload of the recording equipment resulting in audible distortion.

Audio Processors range from basic and inexpensive units to very complex and expensive Digital Multi-band systems.

There are many different makes and types of Audio Processors on the market, most of which are specialised for different applications, such as recording or for AM, FM or TV broadcasting, webcasting etc

An advanced Audio Processor is very forgiving and will help the presenter maintain correct recording or modulation levels, probably making things a little too easy for the student. We suggest initial training be given to the student without the benefit of an Audio Processor so they get the feel for the "raw product".

On the Air

Standard practice in radio broadcasting, is to have an on-air light, mounted outside the studio door (and often inside as well), arranged to turn on whenever a Microphone is switched on.

The Elan Audio AAL-01 On-Air Light operates from a safe 12V DC from the "MERLIN" Mixer which activates when a microphone is turned on Interviews

Audio Editing

Virtually all audio editing these days is done on a personal computer loaded with suitable software – see below for examples.

Interviews may be done in "stereo" using one microphone for the interviewer and one for the interviewee, This allows the level of the two voices to be adjusted or balanced and converted to mono in the editing process, in which unwanted words, pauses and mistakes can be removed.

Basic audio "spots" including background music and effects can be produced easily, using the "MERLIN" Mixer and edited on the PC.

Complete radio programs intended for eventual later broadcasting, complete with announcements, music and "spots" can be produced on the "MERLIN", recorded on a PC or flash card recorder and then edited on the PC to take out minor mistakes.

During editing, the student can also make time corrections to make the program the exact duration specified by the lecturer and finally "burn" this to CD for later broadcast or archiving

Using a flash card recorder to record the "raw" program, is a very practical method, as only one PC will be required in the training studio.

Thoughts about PCs

A modern PC provided with a USB port, sound card and CD burner, loaded with suitable software is an absolute necessity for media training as well as for simulated and live broadcasting. A notebook/laptop PC has the features needed and is most convenient.

A few applications are suggested here:

- Transfer of recorded field interviews and other from flash card recorder to the PC using USB.
- Live recording in the studio, interviews and voiceover segments for use in "spots".
- Recording of basic music and songs.
- Editing of interviews and other recorded material.
- Creating "spots" by combining voice, music and effects by editing.
- Compressing or "ripping" edited and other recorded material to MP3 or other compressed format.
- Storage of recorded audio material including "spots" and music tracks for later playback.
- Playback of stored "spots" during training.
- Playback of stored "spots" and music tracks during live broadcasting.
- Transfer from recorder and editing of recorded programs for later broadcasting.
- Burning recorded material to CD for archiving or later broadcasting. **SC**

*** Principal, Elan Audio**

For more information, visit Elan Audio's website – www.elan.com.au, or call them on (08) 9277 3500. Elan Audio are located at 2 Steel St, South Guildford, WA 6055.

A few useful software programs:

Audacity: http://audacity.sourceforge.net/
Available free from the Internet; audio recording and editing software package, easy to use, works well.

Alto MP3 Ripper: http://www.yuansoft.com/
Available for US $ 29.95c from the Internet, probably the best wave to MP3 converter or "ripper".

MP3 Gain: http://mp3gain.sourceforge.net/
Available free from the internet, the best audio level normalizer we have come across.

Windows Media Player: http://www.microsoft.com/windows/windowsmedia/default.mspx
Normally part of Microsoft Windows operating system, upgrades available free from the Internet, useful as a very basic "spot" playback utility (not particularly good but it works!).

DirEttore: http://www.mixtime.com/
Basic version available free from the internet, basic broadcast automation package, very useful for "spot" and music track playback, looks good on PC monitor screen, works rather well. Please note, It is OK to use DirEttore during training for playback of "spots" but not recommended for playback of music tracks as this makes presentation too easy! It is OK to use for music tracks during live broadcast

Vintage Radio

By RODNEY CHAMPNESS, VK3UG

Reforming electrolytic capacitors

Capacitors are the most troublesome parts in vintage radio receivers. This month, we look at the various capacitor types and describe an easy-to-build circuit that can be used to reform electrolytics.

IN "VINTAGE RADIO" for October and November 2004, we looked at paper capacitors and described the problems that they can cause. Those articles also described how paper capacitors could be tested for leakage and described the circumstances under which they should be replaced.

In practice, the decision whether or not to replace a leaky capacitor often depends on where it is located in the circuit. In many cases, leaky capacitors in non-critical positions (eg, with low voltages across them) can be left in circuit, as they will have negligible effect on performance. By contrast, capacitors with high voltage across them or in certain critical positions (eg, AGC bypass capacitors and those in bias circuits) should be replaced if leaky.

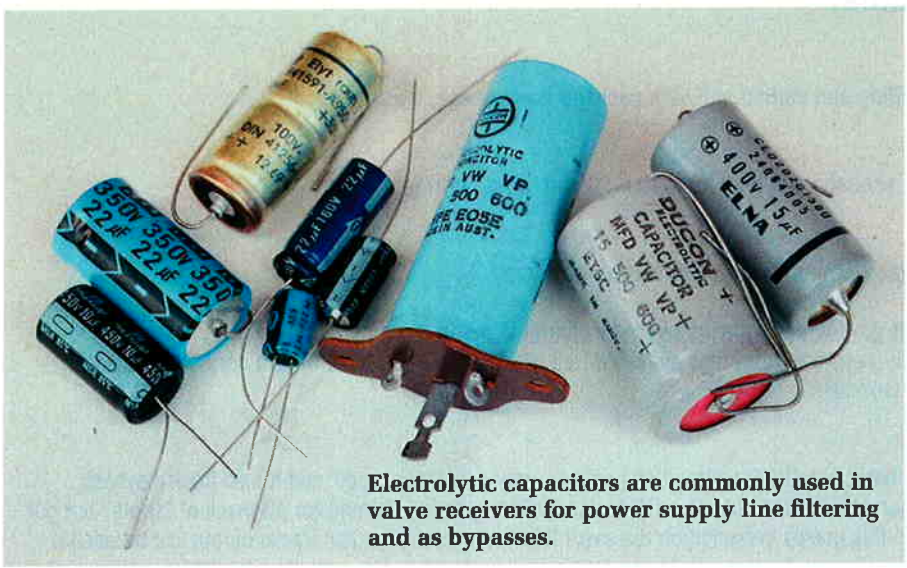
In this article, we'll look first at electrolytic capacitors and describe how they can be reformed (or re-polarised). We'll then take a look at mica, polyester, styroseal (polystyrene), ceramic and air-dielectric capacitors.

Electrolytic capacitors

Electrolytic capacitors are usually used as power supply filters and as bypasses in valve receivers. They are also used as coupling capacitors in low-impedance sections of transistorised receivers.

Polarised electrolytics have positive and negative terminals and must be connected into circuit with the correct polarity. By contrast, bipolar or non-polarised electrolytic capacitors can be connected into circuit either way around, however they are seldom found in radio receivers.

Note that the capacitance values marked on electrolytic capacitors are only approximate. In practice, they and can vary from about 10% low to as much as 50% high. So don't get too upset if the measured value of a nominal 16µF capacitor turns out to be anywhere between say, 14µF and 24µF.



Electrolytic capacitors are commonly used in valve receivers for power supply line filtering and as bypasses.

Main problems

Electrolytic capacitors suffer from two main problems: (1) loss of capacitance and (2) excessive leakage current. The first problem, that of reduced capacitance, occurs because the electrolyte inside the capacitor tends to dry out over the years. As a result, the capacitance of a nominal 16µF power supply filter capacitor may reduce to virtually zero. This will result in hum and/or "motorboating" in the audio output of the receiver and replacement is the only answer.

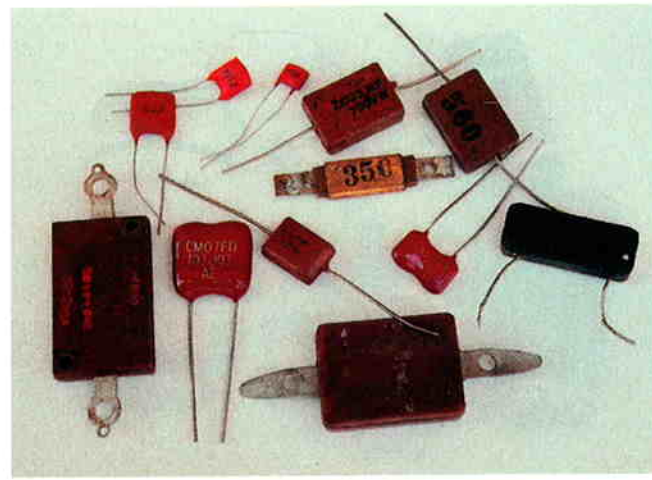
As for the second problem, electrolytic capacitors always have some leakage – usually be less than 1mA. However, an electrolytic capacitor stored for a long period of time can become depolarised. As a result, it will draw considerable current (greater than 40mA in some cases) until it is reformed (by applying a polarising voltage across it).

So how do you reform an electrolytic capacitor? There are three different methods and I'll describe the pros and cons of each. Note that some capacitors will not respond to the reforming process and will need replacement.

Reforming method 1

Regrettably, some vintage radio col-

Polyester capacitors became available in the late 1960s, towards the end of the valve era, and are very reliable.



Mica capacitors usually have relatively low values and are typically used as RF bypasses, in tuned circuits.

lectors try the brute force method of reforming electrolytic capacitors – by giving the set a "smoke" test without first checking the power supply and for faults on the HT line. In many cases, this is exactly what does happen – smoke appears as soon as power is applied.

Often, a set will have been put aside because it has a fault and subsequently stored in less than ideal conditions which leads to further deterioration. This makes it extremely risky to turn any old set on before checking it thoroughly. There may be shorted capacitors or capacitors that are so leaky that they may explode after a short time. In the process, they may destroy the rectifier and perhaps even the power transformer.

A leaky paper audio-coupling capacitor could also cause the audio output valve to draw excessive current, destroying the valve in the process. In short, turning a set on without checking it can produce some rather expensive smoke.

Reforming method 2

Over the years, I have often used a method that some people consider risky when it comes to reforming electrolytic capacitors. First, I check that there are no short circuits on the HT line and that the minimum resistance from the HT line to chassis is at least 10kΩ (the actual value will depend on the circuit). In addition, if an initial physical check shows that any capacitors are bulging or leaking electrolyte, I replace them.

That done, I connect a multimeter via insulated short jumper clip leads across the first electrolytic capacitor and observe the rising voltage as the set is turned on for a brief period. This period is around 20 seconds for a set with an indirectly-heated rectifier and just a few seconds with a directly-heated rectifier.

In practice, I let the voltage rise to about a quarter of the expected HT voltage and then turn the set off. If the rectifier shows any sign of distress (red colour on the plates or sparks inside the works), I turn the set off immediately and recheck for shorts.

After about a minute, I then repeat the procedure, this time letting the voltage rise a little higher. If the electrolytic is reforming, the voltage across it will rise to the expected HT voltage after a few cycles of this procedure.

Note that it's necessary to check the second filter capacitor as well. I've sometime found that one capacitor would reform but not the other. Note also that more modern electrolytics don't seem to need much reforming. If an electrolytic capacitor shows any signs of overheating, it should be discarded as it obviously has far too much leakage.

What are the advantages of this method? It will successfully reform capacitors over a period of a few minutes of on-off switching. It has the advantage that no capacitor has to be removed from the set to do the reforming. If used with care in the manner described above it would be rare for any damage to occur in the receiver. What are the disadvantages? It is a bit harsh and if care is not taken the end result will be damage similar to that which occurs with the previous "smoke test" method.

(Editor's note: we regard this method as decidedly risky. While initial resistance checks may indicate nothing amiss, when the voltage across a suspect capacitor rises to a critical value, the leakage current may suddenly increase or it may become short-circuit which can immediately damage the rectifier. If the capacitor then suddenly leaks all over the chassis, you then have a major clean-up job. And the smell is something you will remember for the rest of your life! Finally, an

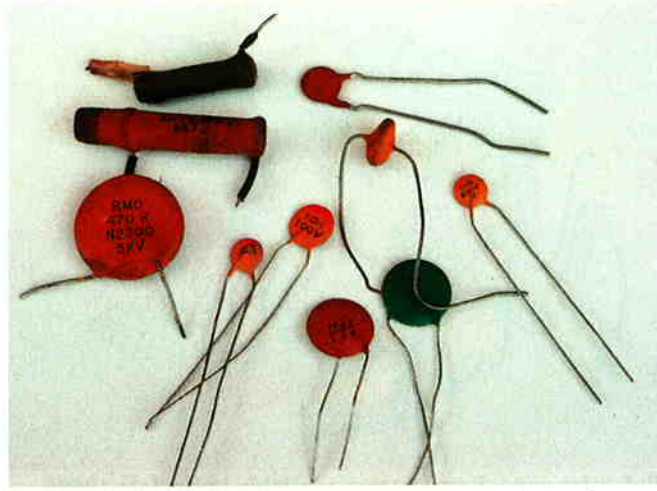
WHERE can you buy SILICON CHIP?

You can get your copy of **SILICON CHIP every month from your newsagent**: in most it's on sale on the last Wednesday of the month prior to cover date. You can ask your newsagent to **reserve your copy** for you. If they do not have **SILICON CHIP** or it has run out, ask them to contact Network Distribution Company in your state.

SILICON CHIP is also on sale in all Jaycar DICK SMITH ELECTRONICS ALTRONICS stores . . . again, you can ask the store manager to reserve a copy for you.

Or, to be sure that you **never miss an issue** and **save money into the bargain**, why not take out a subscription?
The annual cost is just $83 within Australia or $89 (by airmail) to New Zealand.
Subscribers also get **further discounts** on books, and other products we sell.

Styroseal capacitors became available around the same time as polyester capacitors and are quite reliable.



Early ceramic capacitors were not very reliable but later types gave few problems.

exploding electrolytic capacitor poses an extreme risk to your eyes!)

Reforming method 3

Method number 3 is much more benign and involves using a special DC power supply. This supply should be voltage regulated (so that the applied voltage can not exceed the peak voltage rating of the capacitor) and should feature current limiting.

In operation, the capacitor is connected to the output and the current limiting set to 10mA. This current limit applies whether the voltage across the capacitor is 5V or 500V (or what ever the maximum working voltage happens to be).

When the capacitor has reformed, the voltage across it will be at the selected reforming voltage, while the current will have reduced to a fraction of a milliamp in most cases. However, if the current remains at about 10mA and the voltage doesn't risen to the selected reforming voltage, the capacitor is suspect and should be replaced.

You can get a good idea as to just how well a capacitor is holding a charge by disconnecting it from the supply and observing how quickly the voltage across it decreases with just a digital multimeter in place.

(Be careful though – a capacitor charged to a high voltage can deliver a fatal shock. Always make sure that a capacitor is fully discharged before touching it).

This method of reforming has a couple advantages. First, provided it's done properly, with the voltage increased in stages, no undue stresses are placed on either the capacitor or the test instrument. Second, it shows just how good a capacitor is and gives an indication as to whether it should be used or not.

What are the disadvantages? If the capacitor is "new old stock" and is out of circuit, there are no disadvantages. However, if it is in-circuit, it may need to have one lead disconnected.

A simple and very effective repolariser/reformer test instrument is described later in the article.

Mica capacitors

Mica capacitors usually have relatively low values and are typically used as RF bypasses, in tuned circuits and as vibrator buffer capacitors, etc. They are usually quite reliable but they can develop faults that give some strange effects in receivers. For example, local oscillators can drift or jump in frequency, while the audio output can have annoying crackles in it.

A high-voltage tester will usually reveal if a mica capacitor has noticeable leakage and if this leakage resistance fluctuates. Most mica capacitors were made as a "stack" interleaved with sheets of tin foil and mica clamped together and then encapsulated. Sometimes the contact between some metal foils and the clamps becomes intermittent and so the capacitance will vary.

If you don't have a high voltage tester, the easiest way to test whether a mica capacitor is at fault is to replace it and see if this makes a difference.

Mica capacitors can really cause headaches because they can produce very obscure symptoms in a receiver. In fact, it's not uncommon to find that the faulty component is nowhere near where you expected to find it but is in a different section altogether. Faulty local oscillator grid coupling capacitors have led me up the garden path more than once.

Polyester capacitors

Polyester capacitors are usually available in 160V, 400V and 630V DC ratings and take the place of paper capacitors. The most common style became available in the early sixties towards the end of the valve era.

I don't think I have ever had to replace one of the yellow-coloured Philips units – they are just so reliable. In fact, it's a pity they weren't avail-

Forming Electrolytic Capacitors

So what is this "forming" process? Basically it refers to re-forming the aluminium oxide layer on the aluminium foil electrode in the electrolytic capacitor. In essence, the aluminium foil is the positive electrode and the aluminium oxide layer is the dielectric of the capacitor. The conductive electrolytic in conjunction with another small aluminium foil and the aluminium can then forms the negative electrode of the capacitor.

In applying the "forming" current to the capacitor we are setting up a controlled chemical process between the conductive electrolyte and aluminium foil to re-anodise or oxidise the aluminium surface. This heals any breaks in the oxide layer (the dielectric) and thus reduces the leakage current.

able many years earlier - valve radios would have been so much more reliable without paper capacitors.

"Greencaps" and MKT capacitors are also polyester types. However, their voltage ratings can differ from those quoted above.

Styroseal capacitors

Styroseal (polystyrene) capacitors became available around the same time as polyester capacitors and from my experience, are quite reliable. They have been used have been used in much the same way as polyester capacitors and also in tuned circuits to some extent.

Ceramic capacitors

Some early ceramic capacitors were not considered particularly reliable, whereas later types gave few problems. They generally come in two types. One type is used more as a bypass where the exact value is unimportant, whereas the other type is more precise in value and is often used in tuned circuits.

In addition, ceramic capacitors can be manufactured with negative, zero (NPO) or positive temperature coefficients, so that frequency drift in tuned circuits can be compensated for with changes in temperature.

Ceramic capacitors come in a range of voltage ratings from 50V up to several thousand volts. However, they are not usually used in valve receivers, with some exceptions. I now commonly use 47nF (0.047µF) 50V ceramic capacitors on AGC lines as replacements for leaky paper capacitors. They are small and can often be hidden which helps keep the set looking original.

Air-dielectric capacitors

The air-dielectric capacitors we see in vintage radios are the tuning and trimmer capacitors. And although these items do occasionally have problems, the faults are easily detected.

The problems to look out for are usually just mechanical. In tuning gangs, for example, the rotor (movable) plates may have been bent slightly so that they scrape against the stator (fixed) plates. This will show up as erratic tuning and crackles as the tuning gang is operated. It's easy to track the problems down by removing all connections to the stators, connecting a multimeter (set to ohms) between the stator and the frame and then operating the tuning. As the unit is tuned, any shorts will soon become evident on the meter reading.

By placing a light behind the gang and looking along the plane of the plates, it should be obvious which plates are touching each other. The shorting plates can then usually be carefully bent back to where they should be to clear the shorts.

Sometimes, the meter may show that a short is present but no evidence of plates touching can be seen. In this case, there is probably a small sliver of metal that is shorting the gang. The best method to deal with this problem is to burn the short out.

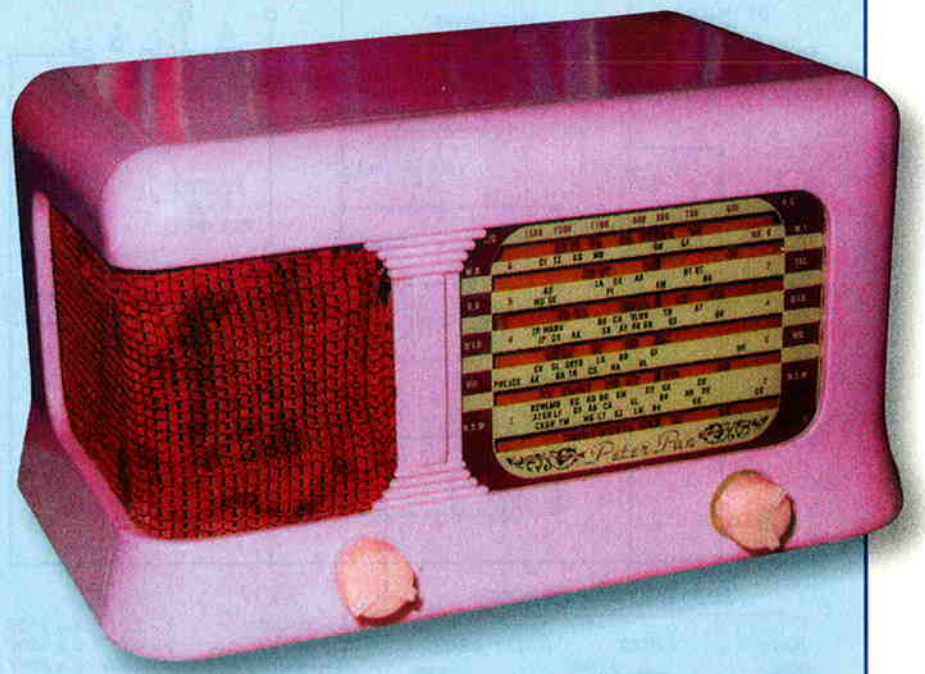
First, check that the gang is still isolated from the circuit, then connect a 47kΩ 1W resistor from the receiver's HT line to the stator. That done, turn the set on and rotate the tuning control from one end to the other and if there is a small sliver of metal causing the trouble, there will be some intermittent sparks between the capacitor plates. This should clear the problem but keep in mind that you are playing around here with a high voltage, so be careful. If you don't understand exactly what you are doing, then don't do it!

Another problem that commonly occurs is the rotor shaft not making good contact with the frame. This can cause jumps in frequency as the receiver is tuned. It can also cause crackles and the set may stop operating. Most, if not all, tuning capacitors have either a metal spring bearing onto the shaft to the gang frame or other spring-loaded contacts to ensure good contact is maintained between the frame and the tuning shaft. If any of these are missing, erratic tuning is almost a certainty.

There is one last problem and that is where the gang has virtually fallen to pieces. This occurs with very old gangs that have been made from poor quality metal and the only answer to this problem is replacement.

OK, now let's take a look at the reformer circuit.

Photo Gallery: Peter Pan GKL 4-Valve Radio



MANUFACTURED IN 1946 by Eclipse Radio, South Melbourne, the GKL was a compact 4-valve reflex superheterodyne receiver housed in a bakelite cabinet. These sets were produced in a number of colours, the pink example shown here being quite rare.
The valve line-up was as follows: 6A8-G frequency changer, 6B8-G reflexed IF amplifier/1st audio amplifier/detector/AVC rectifier, 6V6-GT audio output and 5Y3-GT rectifier. Photo: Historical Radio Society of Australia, Inc.

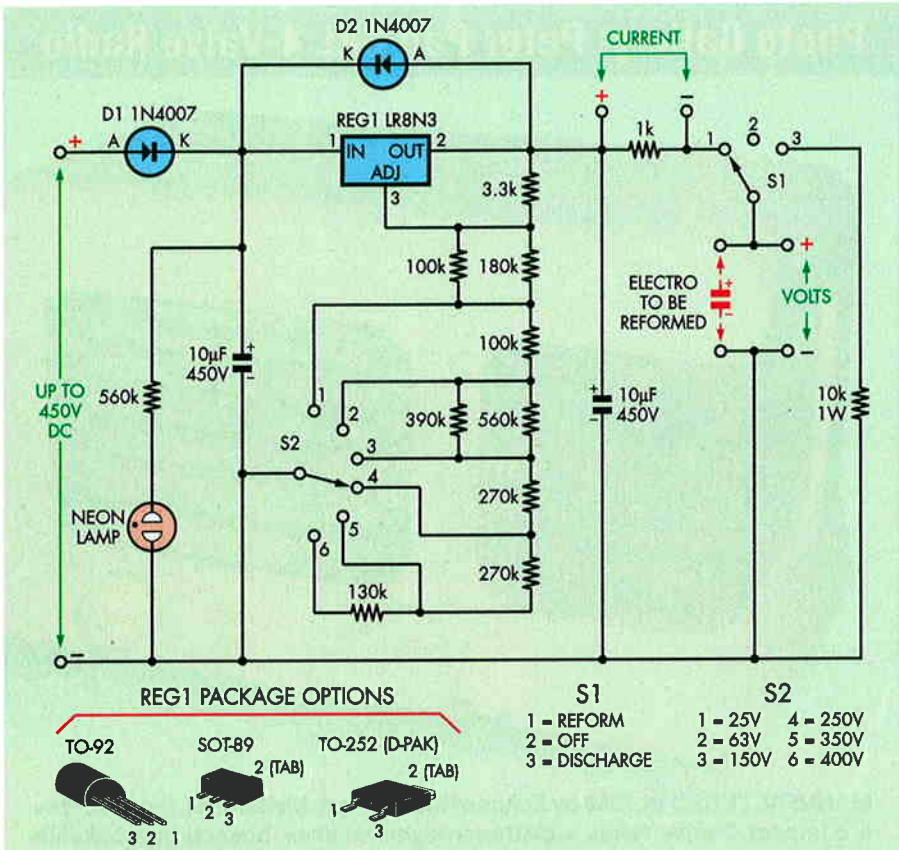


Fig.1: the circuit is based on an LR8N3 3-terminal regulator. Power comes from an external high-voltage DC source – eg, the high-tension (HT) line of a valve receiver or from the 12AX7 Valve Preamp Power Supply described in November 2003 SILICON CHIP.

A Reformer For Electrolytic Capacitors

By RODNEY CHAMPNESS

Simple electrolytic capacitor reformer is easy to build and has six switchable output voltages ranging from 25V to 400V DC.

This simple circuit is based on an LR8N3 voltage regulator which has an input voltage rating of 450V DC and a maximum current output of 20mA – all in a TO92 package.

Fig.1 shows the circuit details. The input to the reformer is powered from up to 450V DC and this can be obtained from a suitable valve receiver. Diode D1 provides reverse polarity protection, while a neon indicator in series with a 560kΩ resistor across the supply line warns users that a high, potentially fatal, voltage is connected to the device.

The reforming voltage (ie, the voltage applied to the capacitor) is set by switch S2 which adjusts the resistive divider connected between the output and adjust terminals of the regulator (REG1). Switch S1 is selects between Reform, Off and Discharge.

The output current is monitored by measuring the voltage across a 1kΩ resistor. In operation, each milliamp through the resistor registers as 1V on the meter. The voltage across the capacitor itself can be measured using a digital multimeter.

When reforming is complete, S1 is switched to the Off position. This allows the operator to observe how quickly the capacitor discharges. The slower the voltage decreases, the less leakage there is in the capacitor.

Finally, S1 is switched to the discharge position. **This discharges the capacitor so that it is safe to handle.**

Note that the discharge resistor is only rated at 1W even though the peak dissipation in the discharge mode is around 16W. However, this is for such a short time that no damage is sustained.

The high-tension (HT) DC input voltage can be obtained from a working receiver. **This receiver MUST USE a mains transformer. Do not even think of connecting the reformer to a transformerless mains-operated set – not if you want to live, that is.** The reformer should be connected to the receiver's HT supply via high-voltage leads and an insulated terminal block.

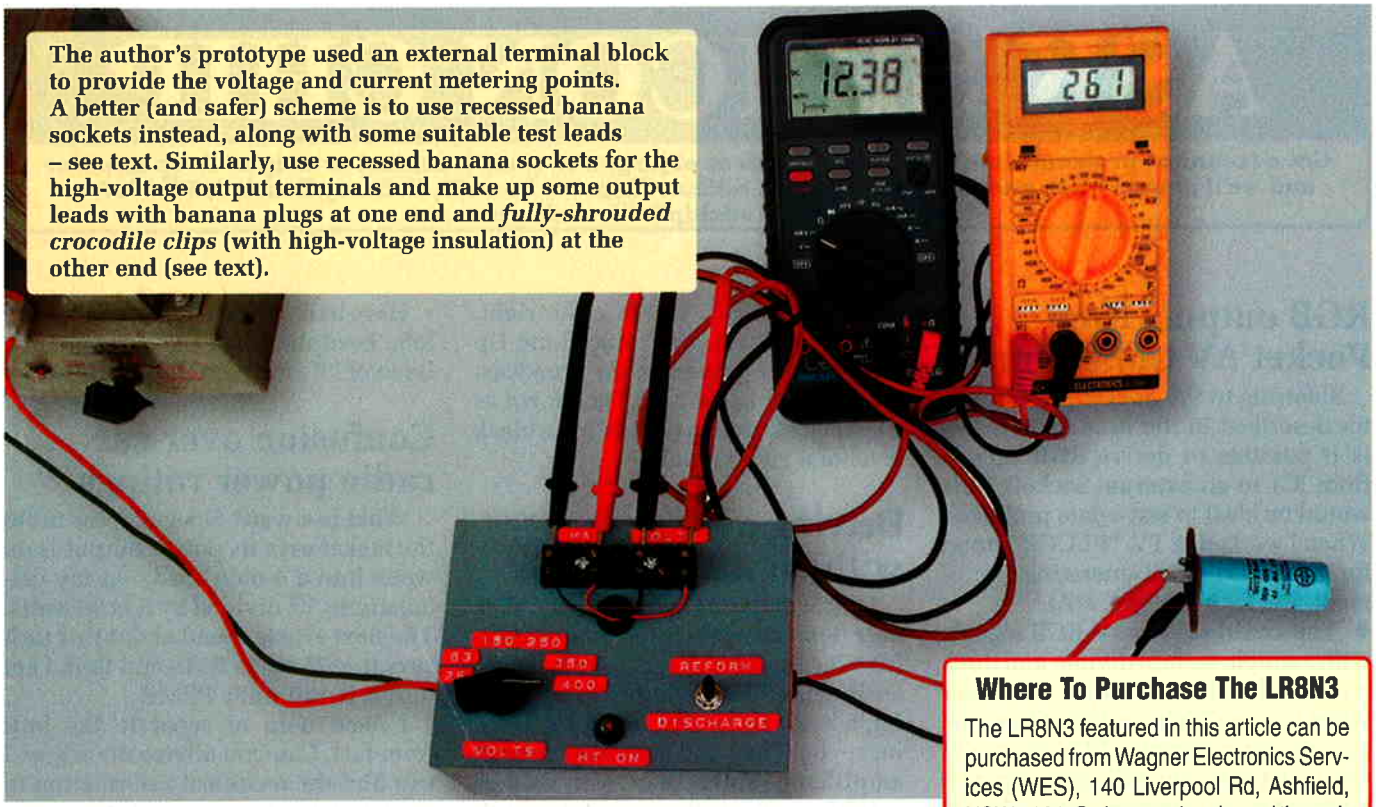
(Editor's note: if you want to build a self-contained unit, the 12AX7 Valve Preamp Power Supply described in November 2003 can be used to provide the HT. As described, this delivers a HT voltage of 260V but you can set this higher by reducing the 47kΩ resistor next to trimpot VR1. Alternatively, you could modify the Valve Preamp Power Supply to do the complete job by having switchable resistors in the feedback network, so that various output voltages could be selected. Note that current limiting using a suitable resistor would be required and you would need to fit a discharge circuit, to discharge the capacitor after reforming).

The author's prototype reformer was built on Veroboard and housed in a small plastic case. If you build the device, remember that it works at high voltages, so keep a liberal spacing between the various parts.

A plastic case is necessary because of the lethal voltages present in this device. **For this reason, be sure to use Nylon screws to mount the board (no metal screws should protrude through the case).** An external insulated terminal block was used for the metering points and I simply tighten down the screws to hold the probes in place.

Safety improvements

Editor's note: instead of using a terminal block, we strongly recommend using recessed banana sockets for the metering points. These can be mounted on an internal bracket and suitably recessed inside the case to eliminate the risk of user contact with high voltages. It's then just a matter of making up some high-voltage meter leads with matching banana plugs.



The author's prototype used an external terminal block to provide the voltage and current metering points. A better (and safer) scheme is to use recessed banana sockets instead, along with some suitable test leads – see text. Similarly, use recessed banana sockets for the high-voltage output terminals and make up some output leads with banana plugs at one end and *fully-shrouded crocodile clips* (with high-voltage insulation) at the other end (see text).

Similarly, we strongly recommend that recessed banana sockets be used for the high-voltage output. A pair of high-voltage output leads (one red, one black) can then be made up, fitted with matching banana plugs. The other ends of these output leads should be fitted with fully insulated (fully shrouded) crocodile clips (also called "safety croc clips").

You can buy fully shrouded crocodile clips with high-voltage insulation from RS Components (www.rsaustralia.com). WES may also have them.

DO NOT use conventional crocodile clips with exposed ends (and minimal insulation), as shown in the photo. Remember – we are dealing with high voltages here.

Using the device

A HT filter capacitor in a receiver that's being restored can be reformed in the following way. First, remove all valves from the receiver and check that there are no shorts or bleeder resistors across the HT line. Alternatively, you can simply disconnect one lead of the capacitor from circuit.

That done, switch S1 to discharge, connect the reformer to the capacitor and select the appropriate reforming voltage (it must not exceed the voltage rating of the electrolytic that's being reformed – or any other capacitors connected to the set's HT line for that matter).

Now switch to the reform position and apply power to the reformer. Initially, the current will be about 12mA but will quickly drop as the LR8N3's thermal protection circuit kicks in. If the capacitor is reforming, the voltage across it will slowly climb until it reaches the reforming voltage.

Finally, when reforming is complete, turn off the power to the reformer and switch S1 to the Discharge position. This will discharge the capacitor and make it safe to remove the leads but you should always use a multimeter connected directly to the capacitor's terminals to confirm that it has indeed discharged before touching it.

Don't simply rely on the discharge circuit – if the discharge resistor goes open circuit, the capacitor will still be charged.

Where To Purchase The LR8N3

The LR8N3 featured in this article can be purchased from Wagner Electronics Services (WES), 140 Liverpool Rd, Ashfield, NSW 2131. Orders can be phoned through to (02) 9798 9233 or faxed to (02) 9798 0017. The part number is LR8N3-G and it is priced at $4.98 plus postage and packing. Payment may be made by cheque, money order or credit card.

The procedure for reforming an electrolytic capacitor out of circuit is virtually the same. **Make sure that the capacitor is securely located on an insulated surface, preferably inside a plastic container).** The whole process can take up to around three minutes, depending on how much reforming is required and the size of the capacitor.

One limitation of this unit has is that the reforming current isn't very high but if the capacitor can be reformed, it will get to the selected voltage in time. It also can not handle 525V and 600V electrolytics but can only reform them to about 400V (depending on the applied HT voltage). SC

WARNING!

This electrolytic reformer circuit operates at lethal voltage. DO NOT build or use it unless you are experienced at working with high voltages and understand exactly what you are doing.

Note that the leads to the capacitor operate at high voltage and that a fully-charged capacitor can deliver a potentially fatal shock. Always discharge the capacitor before disconnecting it from the reformer and use your multimeter to confirm that it has indeed discharged before touching it.

ASK SILICON CHIP

Got a technical problem? Can't understand a piece of jargon or some technical principle? Drop us a line and we'll answer your question. Write to: Ask Silicon Chip, PO Box 139, Collaroy Beach, NSW 2097; or send an email to silchip@siliconchip.com.au

RGB outputs from Pocket AV Generator

Referring to the Pocket AV Generator described in the June 2006 issue, is it possible to derive RGB signals from IC1 to an external socket? This would be ideal to test a data projector. When I worked at TV, "PLUGE" stood for Picture Line Up Generating Equipment. (K. T., Auckland, NZ).

● You could derive 1V RGB signals with a simple voltage divider and three wideband buffering stages, however when you say "data projector" we suspect you're implying a VGA source. If this is the case you will need separate horizontal and vertical sync signals and/or different scan rates.

The 16F84A from the SC TSG generates a composite sync signal which may be unsuitable. It might be better to look for a software alternative with a Google search on monitor test patterns which may be a more appropriate solution as you can use any PC as the generator source. The following link should put you on the right track: **http://www.construnet.hu/nokia/Monitors/TEST/monitor_test.html**

As for PLUGE, you're quite right. It is an acronym for Picture Line Up Generation Equipment. In broadcast circles a "Pluge pattern" is known as a test signal used to calibrate the black level of a video monitor.

Driving a loop with an amplifier

I am wondering whether you have ever done a design for a "loop amplifier" for the hearing-impaired. These are intended for driving extremely low impedance inductive loops in buildings, etc. They are typically current amplifiers rather than hifi voltage amplifiers. Typical power output ratings range from 20VA through to over 120VA.

Alternatively, are any of your power amplifier designs suitable for this purpose? (P. S., Davidson, NSW).

● Any audio amplifier can drive a loop provided that the loop has a DC resistance not less than the rated impedance. For example, an amplifier rated to drive an 8-ohm loudspeaker can drive a loop with a DC resistance of 8Ω or more.

Have look at the article on Induction loop headphones in the October 1995 issue of "Electronics Australia".

Confusion over car radio power ratings

What is a watt? On a 12V car radio the maker says its power output is 60 watts into a 4-ohm load. On my calculations, V^2 divided by R is 36 watts. The next article I read about this unit says it is 25 watts RMS and then I am told it is 120 watts PPMP.

I need help to separate the bull from fact. Can you advise me where I can find the technical information to explain what is a watt? (R. W., Rockhampton, Qld).

● There is a great deal of nonsense surrounding car radio ratings. A good guide is to have a look the input current rating or the fuse. At best, the total power output can only be about 60% of the input power.

Digital delay for SPDIF/ Toslink converter

Thanks for your 2-way SPDIF/ Toslink Digital audio converter in the June 2006 issue. It is just what I need to swap the inputs around and get the DVD into the DVD input and the set-top box into the Video 1 input of the amplifier.

Just one query though: is it possible to modify the design to incorporate a digital delay? An issue that has been raised before by readers of SILICON CHIP is the picture and sound being out of sync when using a plasma display and the sound is being amplified via a standalone 5.1-channel amplifier. Ideally, the delay would be variable so the user could get it just right, depending on the plasma TV set they use.

A one-second delay would be more than enough. (T. H., via email).

● Unfortunately, it would be a major redesign to add a digital delay to the SPDIF converter. Even a fixed delay would require a lot of extra circuitry.

Speed Limiting For All Cars

I am studying the Advanced Diploma of Justice at Chisholm TAFE in Cranbourne. I am doing a Crime Prevention assignment on limiting the speed in all vehicles (with some exceptions) to 120km/h. My strategy suggests implementing this speed reduction in all newly manufactured vehicles by programming the chip in these vehicles.

I was wondering if you could please give me the details on how companies, such as your own, program these chips to reduce speed and also the cost associated with doing so? (K. C., via email).

● We do not program car management chips but it would be relatively easy for car manufacturers to incorporate speed limiting just as they do already with rev limiting in most cars.

However, we do not support the concept of limiting car speed to 120km/h as it is too low. This would make passing manoeuvres on expressways and country roads potentially very hazardous, particularly when passing semi-trailers or road-trains on outback roads. If you suddenly needed an extra burst of speed to overcome a collision hazard, such speed limiting could be fatal. On the other hand, there does not seem to be any need for cars to be able to exceed say, 150km/h.

Caution On The Smart Mixture Meter

I feel I must make some comments regarding the 'Smart Mixture Display' project featured in the April 2004 issue. With an automotive background of over 20 years, many of them spent in powertrain control system development, I believe I am in a position to give an informed view.

Basically, it's always been frowned upon if anyone suggests the addition of extra wiring to any Engine Management System (EMS) component on a road-going vehicle, particularly a sensor that's involved in fuel control, especially the oxygen sensor(s)!

The measurement components generally have unique supply and ground circuits back to the EMS ECU and wiring is optimised with extensive EMC testing to ensure that interference is at an absolute minimum. Adding extra wiring can only compromise this process and new ground connections (which are required for the Mixture Display project) could lead to conditions that upset the balance of differential input measurement systems.

So why are EMS designers so particular about their input circuitry? Fuelling measurement is at the heart of the control of tailpipe emissions. Vehicles are extensively tested to ensure that these meet very strict limits and unless these are achieved, the manufacturer is not permitted to sell and can be fined heavily if they then release vehicles that cannot conform in the "real" world!

There are also implications for the components. For example, it's fascinating to see a catalyst that's caught fire because an engine was running too rich . . . not cheap either! The oxygen sensors not only control the fuelling process but are also used to measure the levels of polluting gases that are coming out the rear end! If emissions limits are exceeded, the dreaded OBD (on-board diagnostics) light comes on in the instrument cluster and manufacturers start to panic! The vehicle might even go into a limp-home mode.

The sensor signals are also used to take account of the "ageing" of an engine during its lifetime and can adapt the calibration to account for this, keeping the performance up to scratch and the emissions in line.

So any errors in the signals can have wide-reaching (and expensive) effects on the car.

Sometimes there are four oxygen sensors on a car – in the exhaust manifold for direct fuelling and downstream to measure catalyst performance. How do you know you're picking the right one? There are many different types too, especially the universal type (definitely not cheap) that give an actual air-fuel ratio rather than the "simple" ones that switch rich/lean. Heater profiles are critical as well, especially considering the current they draw during warm-up.

OK, you may want to fit your own unique sensor(s) and keep clear of the car components but positioning of the oxygen sensor is another significant process – you have to know the gas composition map on exit from the exhaust valve(s) and into the manifold, as you might end up in an area that has a gas mix that is totally unrepresentative of the actual air-fuel ratio. This could require extensive experimentation – even the professionals get it wrong. (S. D., via email).

● It certainly is a worry. However, if you took this approach, no-one would ever lift the bonnet on their car. In brief, the Smart Mixture Meter is designed with a high input impedance so that it does not load the oxygen sensor's signal or the air-flow signal. Nor does the current drawn by the Mixture Meter flow in the ECU monitoring circuits so there can be no upset there.

Finally, the Mixture Meter is designed to work with a standard oxygen sensor that delivers 0-1V and an air-flow sensor delivering 1-5V, as described in the article.

Load-sensing inverter wanted

I notice that most cheap (under $2000) inverters draw around 1A when turned on but not running anything. This can be a problem if you are running solar panels as it adds up over 24 hours.

Is there a way to sense the load on the output of the inverter and have it turn off when no load is detected? Maybe it could be wired into the inverter's on/off switch or remote and have a 3-pin plug to detect the load? Any ideas would be great. (W. W., via email).

● What you need is an inverter that senses whether or not a load is present *before* it powers up. SILICON CHIP has published a number of inverters but none with auto-sensing. However, an auto-sensing inverter designed by John Clarke was published in the September 1985 issue of "Electronics Australia".

Flickering flame doesn't flicker

I purchased and constructed the "Flickering Flame" (SILICON CHIP, October 1997) recently and my halogen lamp will not flicker as described but it pulses to a constant beat. (P. R., via email).

● It seems that one oscillator isn't oscillating or the summing section isn't working.

You should be able to check that both oscillators are working with a multimeter. Checking the summing of the two oscillators really needs an oscilloscope but the circuit is so simple that it either works or it doesn't.

Check all component values, their polarities and the soldering. The chances are something is in the wrong way around or is a wrong value. Many thousands of these units have been built and the only problems have been components or bad soldering.

Replacement Mosfet for battery charger

I am doing some repairs to the 10A battery charger described in the June 1996 issue. The MTP75N05 output N channel Mosfet is burnt out and needs

Clarification Needed On Digital Fuel Adjuster

I have purchased a DFA (digital fuel adjuster) and hand controller (as described in *Performance Electronics for Cars*) which I intend to use on my twin-turbo Toyota Soarer.

I am unsure as to how to connect the unit to my car. My understanding is that you adjust the signal from the MAP sensor. This is done at different RPM points to achieve a very flat AFR (air-fuel ratio) over the entire RPM range.

From reading the instructions I can only see that two inputs: 12V and the MAP sensor input and output to the ECU. I believe that the PM signal wire from the MAP sensor is where the DFA is tapped into.

If this is correct, how does the unit determine what RPM the engine is running at; ie, what load point. Shouldn't the unit also have at least one other input for RPM? I believe the SAFC which performs the same task also has input from RPM and knock sensors which helps to prevent detonation. How does the DFA achieve this? (D. W., via email).

● The DFA is essentially a single parameter device that takes the voltage input and modifies it according to the changes you make using the hand controller. The load points are the input voltage steps.

A single parameter modifier works because essentially it does not operate on its own but in conjunction with the car's ECU that takes the modified voltage values from the DFA and calculates new parameters based on engine RPM (and other sensors) to provide a new fuel/ignition map.

Single parameter modifiers are easier to use and map than modifiers that have two inputs (eg, airflow input and RPM) but can provide essentially the same results because of the way the ECU interprets the information.

replacing but is not mentioned in current DSE, Jaycar or Altronics catalogs. Could you suggest a modern equivalent, please? (P. M., via email).

● The MTP75N05 is a 75A 50V N-channel Mosfet in a TO-220 package. Equivalents are the SUP75N06-08 and the STP75NF75. The STP75NF75 is the best value for money at $4.96 plus GST from Farnell, while the SUP75N06-08 is $22.55 plus GST. The catalog number for the STP75NF75 from Farnell is 816-5289. Contact **www.farnellinone.com.au**.

How to zap Nicad batteries

I read about the zapping procedure to rejuvenate a lead-acid battery in the May 2005 issue. What is the process to zap a Nicad battery? (5V into a capacitor, then BAM! Right? How big a capacitor should be used?).

Also, there are two zapping processes, one to rejuvenate a pack (remove dendrites) and one to decrease internal resistance. Could you describe both procedures? (C. W., Wild Omar, Ca, USA).

● There is only one process to zap nicad cells and in fact, we published a Nicad Zapper in SILICON CHIP for August 1994. It charges a large capacitor to 33V and zaps the nicad cell in 5ms bursts.

Computer TV card problems

I have tried several computer TV cards and they all seem to have similar problems. I have only tried cards that offer digital tuning; some cards offer both analog and digital tuning. Some will not tune to all local TV stations; eg, Prime TV in Albury. Some will not burn a DVD if the TV card records to hard drive in anything other than 720 x 576 MPEG 2.

Some channels are recorded as 1440 x 1080 AC3, 1280 x 1080 AC3 and 704 x 480 MPEG-2. These three cause an error message from the TV card burn software, such as "Invalid Format" or "Data Rate Exceeds Specification, DVD Specification Violation".

When a program is successfully burnt to DVD, there is always a very distracting and annoying delay between audio and the picture – ie, the audios lags by about half a second.

Advice from the manufacturer concerning the "Invalid Format" problem resulted in a reply of "burn it as a data disk". Only problem is, not many DVD players recognise this format (MPEG-2 and AC3). Do you know of any TV card that does not have these problems or do you know of any way around them? (T. B., Wodonga, Vic).

● We do not know the answers to these questions. Perhaps one of our readers can help.

Capacitor polarity for audio generator

I have been playing with low frequencies using two audio signal generators: Dick Smith Electronics Q-1310 and Jaycar TAG-101. Well, I learnt the hard way and connected the Q-1310 to a device with a 9V DC supply. It cooked internally. The manual suggests to "connect a high grade capacitor, 20µF or more with ample voltage rating, in series with the 'hot' lead".

The TAG-101 manual says nothing on this topic but I believe it would be prudent to take the above instructions as well. To the best of my knowledge such a capacitor is only available in electrolytic form. As I have little interest in cooking, I need to connect it with correct polarity. Which way is that? (C. H., via email.

● Since the polarity of any external load DC supply is unknown and you don't want to have to measure voltages each time you make a connection, you really need to use a non-polarised electrolytic capacitor.

Hydrogen booster for cars is a fraud

I was wandering if you are intending doing a "hydrogen booster" project for cars. There has been a lot of talk about alternative energies and this would seem to be an ideal project for SILICON CHIP and could benefit many. (J. S., Geelong, Vic).

● These devices are a fraud. It is amazing how these scams to extract better fuel consumption keep coming and this is just another one of them. To quote from one website:

"This Hydrogen Booster is an electrolysis device that is installed under the car or truck hood and runs off the vehicle's electrical system. Amperage is applied to a canister of ionised water through stainless steel electrodes

whereby hydrogen and oxygen are produced on-demand at low pressure. This fuel combination is then added into the fuel intake manifold. The combination provides for more complete combustion (98%) on the power stroke and reduces both particulate and gaseous emissions between 50-98%."

In other words, the electrolysis device takes power from the engine (which is fed by petrol), dissociates water into hydrogen and oxygen and then burns it in the engine. Even supposing that the dissociation process works, given that all steps in the process (alternator charging battery, dissociation, combustion etc) involve less than 100% efficiency then the whole process *must* be less efficient than the simple process of using just petrol to power the engine!

Nor is there any chance of producing less gas emissions or particulates.

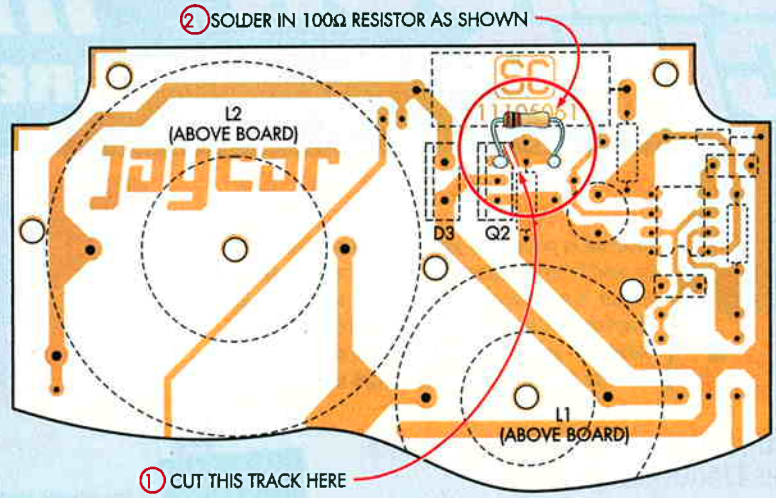
Halogen floodlight simpler than LEDs

I am contemplating the construction of a flood lamp for my digital video camera, using four 3W LED lamps. To keep the whole assembly as compact as possible, I am considering just using a resistor as a current regulator and a voltage sensing circuit set at mid-point between the minimum and maximum voltage for the LEDs.

I will be using a 12V battery pack, as the LEDs will only be on for short periods at a time. Can you see any major problems? (C. B., via email).

● We don't see any problems with your proposal but a 12V 20W halogen lamp would be more efficient than LEDs as well as being a lot simpler and cheaper. SC

Notes & Errata



UNDERSIDE VIEW OF TOP END OF BOARD

Fig.1: follow this diagram to fit a 100Ω stopper resistor to the Lead-Acid Battery Zapper & Condition Checker.

Lead-Acid Battery Zapper & Condition Checker, May 2006: it has been found that some STP60NF06 MOSFET devices can oscillate in the Q2 pulse switching stage, typically at about 200kHz. This causes coils L1 and L2 to overheat, LED1 to glow much brighter than normally and then fuse F1 to blow. It may also cause Q2 and/or damper diode D3 (BY229-200) to be destroyed, before the fuse blows.

To prevent this problem, a 100Ω 0.5W resistor must be connected in series with the gate lead of Q2 to act as a "stopper". On existing PC boards, this resistor can be fitted underneath the board, after cutting the copper track as shown in the above diagram (Fig.1).

Galactic Voice, September 2006: the 10µF capacitor that bypasses the supply for the electret microphone at the top lefthand corner of the circuit diagram (p68) should be 100µF. Also, the capacitor just to the left of the loudspeaker leads on the overlay diagram (p69) should be 100µF, to agree with the circuit.

The parts list should show 9 1kΩ resistors, not 7. Finally, the text on page 73 refers to the LED flashing; it does not flash.

Ultrasonic Eavesdropper, August 2006: the code number for the PC board for this project has been changed to 01208061 to avoid confusion with the Magnetic Cartridge Preamplifier board.

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely.

Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

Advertisers are warned that they are responsible for the content of all advertisements and that they must conform to the Trade Practices Act 1974 or as subsequently amended and to any governmental regulations which are applicable.

SILICON CHIP REFERENCE

GREAT BOOKS FOR

ALL PRICES INCLUDE GST AND ARE

NEW NEW NEW NEW

$83

AUDIO POWER AMPLIFIER DESIGN HANDBOOK by Douglas Self 4th Edition 2006

Reduced in price from previous edition! From one of the world's most respected audio authorities. New 4th edition is more comprehensive than ever – now with new chapters on Class D amplifiers and DC servos. Now even bigger – 465 pages in paperback. ***See the review in September 2006 issue.***

$48

THE WIRELESS NETWORKING STARTER KIT by Engst & Fleishman.

2nd Edition, Published 2004.

If you've ever wanted to know the intricate details of setting up your own wireless network and the traps for young players, you'll find it here. (See review July 05 SILICON CHIP) 530+pages in paperback.

Practical Variable Speed Drives and Power Electronics

by Malcolm Barnes. 1st Ed, Feb 2003.

An essential reference for engineers and anyone who wishes to design or use variable speed drives for induction motors. As reviewed in SILICON CHIP September 2003. 288 pages.

$85

AUDIO ELECTRONICS

By John Linsley Hood. First published 1995. Second edition 1999.

For anyone involved in designing, adapting and using analog and digital audio equipment. Covers tape recording, tuners and receivers, preamplifiers, voltage amplifiers, audio power amplifiers, compact disc technology & digital audio, test & measurement, loudspeaker crossover systems, power supplies and noise reduction systems. 375 pages in soft cover.

$92

$73

Microcontroller Projects in C for the 8051 by Dogan Ibrahim. Published 2000.

Through graded projects introduces the fundamentals of microelectronics, the 8051 family, programming in C and the use of a C compiler. Provides an interesting, enjoyable and easily mastered alternative to more theoretical textbooks. 178 pages in paperback.

$89

ANALOG ELECTRONICS

By Ian Hickman. 2nd edition 1999.

Essential reading for electronics designers and students alike. It will answer questions about core analog theory and design principles as well as offering practical design ideas. Many of the circuits taken from Ian Hickman's magazine articles. 294 pages in soft cover.

Servicing TV Satellite & Video Equipment

By Eugene Trundle. **Revised edition 2002**.

Written by a practising service engineer, emphasis is on practical business of fault diagnosis and repair. Covers TV power supplies, line timebases, video deck machines, test gear, intermittent faults, repair techniques and workshop practice. Features a completely new chapter on the latest digital equipment – DVD, set-top boxes, digital satellite TV and digital TV sets.

$70

Power Supply Cookbook

by Marty Brown. 2nd edition 2001.

An easy-to-follow, step-by-step text for a wide variety of power supplies. All described in simple language. Anyone with a basic knowledge of electronics can create a very complicated power supply design. 265 pages in paperback.

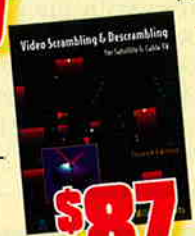
$99

$63

Interfacing With C by Howard Hutchings

Revised by Mike James. 2nd edition 2001.

Anyone interested in ports, transducer interfacing, analog to digital conversion, convolution, filters or digital/analog conversion will benefit from reading this book. The principals precede the applications to provide genuine understanding and encourage further development. 302 pages in paperback.



$87

VIDEO SCRAMBLING & DESCRAMBLING FOR SATELLITE & CABLE TV

by Graf & Sheets –2nd Edition

Ever wondered how they scramble video on cable and satellite TV? This book tells you! Encoding/decoding systems (analog and digital systems), encryption, even schematics and details of several encoder and decoder circuits for experimentation. For both the hobbyist and the professional. 290 pages in paperback.

PRACTICAL RF HANDBOOK

by Ian Hickman 3rd Edition 2002

A guide to RF design for engineers, technicians, students and enthusiasts. Covers all of the key topics in RF: analog design principles, transmission lines, couplers, transformers, amplifiers, oscillators, modulation, transmitters and receivers, propagation & antennas. 279 pages in paperback.

$69

DVD PLAYERS AND DRIVES

by K.F. Ibrahim. Published 2003.

A guide to DVD technology and applications, with particular focus on design issues and pitfalls, maintenance and repair. Ideal for engineers, technicians, students of consumer electronics and sales and installation staff. As reviewed in Silicon Chip February 2004. 319 pages in paperback.

$79

$119

Op Amps for Everyone

Edited by Ron Mancini Published 2003

Compiled by Texas Instruments, this is the closest thing to a "bible" on op amps. This is an engineer's reference with lots of theory, plenty of maths and right up-to-the-minute with modern devices. Not cheap but worth every cent. 478 pages, soft covers.

$89

Complete Reference Red Hat

by Petersen and Haddad Published 2004

If you're into Linux you've got to have this latest omnibus reference covering Red Hat Enterprise Linux and Fedora. Great for internet server management, firewalls, encryption, authentication and more. Includes DVD. 832 pages, soft covers.

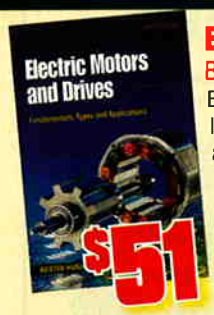
108

BOOKSHOP

ENQUIRING MINDS!

LOWER THAN RECOMMENDED RETAIL PRICE

10% OFF! WANT TO SAVE 10%? SILICON CHIP SUBSCRIBERS AUTOMATICALLY QUALIFY FOR A 10% DISCOUNT ON ALL BOOK PURCHASES!



ELECTRIC MOTORS AND DRIVES

By Austin Hughes - Third edition 2006

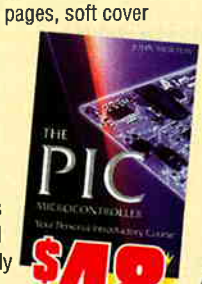
Brand new edition of this amazingly popular book. Intended for non-specialist users of electric motors and drives, filling the gap between academic texts and general "handbooks". Explores all of the widely-used modern types of motor and drive including conventional & brushless DC, induction motors, steppers, servos, synchronous and reluctance. 384 pages, soft cover

$51

PIC MICROCONTROLLER – PERSONAL INTRODUCTORY COURSE

By John Morton NEW: 3rd edition 2005.

A unique and practical guide to getting up and running with the PIC. It assumes no knowledge of microcontrollers – ideal introduction for students, teachers, technicians and electronics enthusiasts. Revised 3rd edition focuses entirely on re-programmable flash PICs such as 16F54, 16F84 12F508 and 12F675. 226 pages in paperback.



$48

ANALOG TECHNIQUES WITH DIGITAL INTERFACING

by T H Wilmshurst – Published 2001.

$69

Covers all the analog electronics needed in a wide range of higher education programs: first degrees in electronic engineering, experimental science course, MSc electronics and electronics units for HNDs. Text is supported by numerous worked examples and experimental exercises. 312 pages in paperback.

GUIDE TO TV & VIDEO TECHNOLOGY

By Eugene Trundle – 3rd Edition 2001

$63

Eugene Trundle has written for many years in Television magazine and his latest book is right up to date on TV and video technology. Includes both theory and practical servicing information and is ideal for both students and technicians. 382 pages, in paperback.

PIC IN PRACTICE

by D W Smith. New 2nd Edition - published 2006

$56

Based on popular short courses on the PIC, for professionals, students and teachers. Can be used at a variety of levels. An ideal introduction to the world of microcontrollers for hobbyists, students and professionals. 255 pages in paperback.

RADIO, TV AND HOBBIES April 1939 to March 1965 – Every article to enjoy once again on DVD-ROM!

NEW NEW NEW NEW

This remarkable archival collection spans nearly three decades of Australia's own "Radio and Hobbies" then "Radio TV and Hobbies". Every article has been painstakingly scanned into PDF format – ready to read at your leisure on your computer (obviously, a computer DVD-ROM reader is required along with Acrobat Reader). For history buffs, it's worth its weight in gold. For vintage radio enthusiasts, what could be better? For anyone interested in electronics, this is one which you ***MUST*** have in your collection!

$62

AMATEUR SCIENTIST TWIN CD SET – *NOW NEW V3.0: Includes bonus science software library*

$62

Many thousands of copies now sold. Two incredible CDs containing over 1000 classic projects, sourced from Scientific American over the past 73 years – and covering every field of science. This new "Dr Shawn" edition is the latest version – it's said to be even more user friendly with much more information and data. Runs with any browser. Recommended by the National Science Teachers Association (USA).

NEW NEW NEW NEW

ORDER NOW BY PHONE OR FAX

NOTE: ALL PRICES ARE PLUS P&P – SEE BELOW.

ORDER HERE

☐ **AMATEUR SCIENTIST CD**	**$62.00**
☐ ANALOG CIRCUIT TECHNIQUES W/DIGITAL INT.	$69.00
☐ ANALOG ELECTRONICS	$89.00
☐ AUDIO ELECTRONICS	$92.00
☐ AUDIO POWER AMPLIFIER DESIGN	~~$89.00~~ $83.00
☐ COMPLETE REFERENCE RED HAT	$89.00
☐ DVD PLAYERS AND DRIVES	$79.00
☐ ELECTRIC MOTORS AND DRIVES	$51.00
☐ EMC FOR PRODUCT DESIGNERS	$103.00
☐ GUIDE TO TV & VIDEO TECHNOLOGY	$63.00
☐ INTERFACING WITH C	$63.00
☐ M'CONTROLLER PROJECTS IN C FOR 8051	$73.00
☐ OP AMPS FOR EVERYONE	$119.00
☐ PIC IN PRACTICE	$56.00
☐ PIC MICROCONTROLLER - PERSONAL INTRO COURSE	$48.00
☐ POWER SUPPLY COOKBOOK	$99.00
☐ PRACTICAL RF HANDBOOK	$69.00
☐ PRACT. VARIABLE SPEED DRIVES/POWER ELECT.	$85.00
☐ **RADIO, TV AND HOBBIES ON DVD-ROM**	**$62.00**
☐ SERVICING TV SATELLITE & VIDEO EQUIPMENT	$70.00
☐ THE WIRELESS NETWORKING STARTER KIT	$48.00
☐ VIDEO SCRAMBLING/DESCRAMBLING	$87.00

TAX INVOICE

Your Name _____

PLEASE PRINT

Address _____

_____ Postcode _____

Daytime Phone No. (____) _____

Email _____ STD @ _____

Payment details:

☐ Cheque/Money Order enclosed ***OR***

Charge my credit card – ☐ Bankcard ☐ Visa Card ☐ MasterCard

No: ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

Signature _____ Card expiry date ☐☐ ☐☐

BOOK TOTAL: $..... PLUS P&P: $..... ORDER TOTAL$ AU.....

P&P Australia: $7.00 *PER ORDER*
NZ: $A12 per book
Elsewhere: $A18 per book

POST TO: Silicon Chip Publications, PO Box 139, Collaroy NSW, Australia 2097.
OR CALL (02) 9939 3295 & quote your credit card details; or **FAX TO** (02) 9979 6503

*ALL TITLES SUBJECT TO AVAILABILITY. PRICES VALID FOR MONTH OF MAGAZINE ISSUE ONLY. ALL PRICES INCLUDE GST

MARKET CENTRE

Cash in your surplus gear. Advertise it here in Silicon Chip.

CLASSIFIED ADVERTISING RATES

Advertising rates for these pages: Classified ads: $27.00 (incl. GST) for up to 20 words plus 80 cents for each additional word. Display ads: $49.50 (incl. GST) per column centimetre (max. 10cm). Closing date: five weeks prior to month of sale.

To book your classified ad, email the text to silicon@siliconchip.com.au and include your credit card details, or fax (02) 9939 2648, or post to Silicon Chip Classifieds, PO Box 139, Collaroy, NSW, Australia 2097.

Enclosed is my cheque/money order for $_____ or please debit my

❑ Bankcard ❑ Visa Card ❑ Master Card

Card No. | | | | | | | | | | | | | | | |

Signature_____ Card expiry date____/____

Name _____

Street _____

Suburb/town _____ Postcode_____

Phone:_____ Fax:_____ Email:_____

FOR SALE

More control solutions for you!
NEW K145Server: monitor temperatures in server rooms, hothouses etc remotely over the web for less than $100.
NEW 500oz-in plus Stepper Motor: may not be the fastest motor on the block but it has real grunt.
NEW DC Motor Controllers from Pololu: these motor controllers have been designed for robotic applications. Range from mini dual 1A controllers to 30A.
NEW Servo Motor Controllers from Pololu: control your R/C servo motors with our serial servo controllers Ideal for robotic applications. Control up to 8 servos with the one card.
Netiom Link: automatically transfer digital inputs and outputs between two cards over an Ethernet link.
Electronic Thermostats with digital temperature display; two control relays; can be used in heating and cooling. NTC thermistor or J T/C or Pt100 sensors.
Low Cost Mini Panel Meter Displays: programmable 4-20mA $155 and Tachometer $129.
Isolated RS232 to RS485 converters.
USB to RS422/RS485 converter with 1500V Isolation, RTS or Auto Data Flow control.
Signal Conditioners non isolated and isolated: convert thermocouples, RTDs to 4-20mA or 0-10V Fully programmable.
Stepper Motors: we have a selection of Stepper motors for hobby and high torque CNC applications.
DC Motors for both hobby and high torque applications.
DC, Stepper and Servo Motor controller kits.
Serial and Parallel Port relay controller cards.
PIC MicroProgrammers: serial and USB port operated.

MicroByte Electronics

Development / Training Board For the PIC Micro

The Most Flexible Development board Around!
Based on the PIC16F877. The development board can be used with a wide variety of PIC Micro's including the PIC18F452. Adaptors available to use the 8,14,18 & 28 pin PIC Micro's. ICD 2 connector allows In circuit programming / Debugging with Microchips ICD 2. Uncommitted I/O ports allows for your own connection configuration to each device and also to external circuits. Onboard parallel port programmer allows programming of the PIC while still connected to the circuits. Other optional extras available. Connection to each circuit module or external circuit is made via 10 way IDC cables provided. CoreChart compatible - Program the PIC directly from CoreChart, the easy to use flow chart Icon based assembler.

For more information...
Visit: www.microbyte.com.au
Phone: (03) 9378 4288
Email: info@microbyte.com.au

20 years experience! SPEAKERBITS

HI-FI SPEAKER REPAIRS

YOUR EXPERT SPEAKER REPAIR SPECIALISTS

Specialising in UK, US and Danish brands.
Speakerbits are your vintage, rare and collectable speaker repair experts. Foam surrounds, voice coils, complete recone kits and more. Original OEM parts for Scan-Speak, Dynaudio, Tannoy, JBL, ElectroVoice and others!

tel: 03 9647 7000 www.speakerbits.com

Switch Mode, Battery Chargers and DC-DC converters.
Full details and credit card ordering available at **www.oceancontrols.com.au** Helping to put you in control.

WEATHER STATIONS: windspeed & direction, inside temperature, outside temperature and windchill. Records highs and lows with time and date as they occur. Optional rainfall and PC interface. Used by government departments, farmers, pilots and weather enthusiasts. Other models with barometric pressure,

Resist Weather Intrusion

GRAETZ
SP475FPV
Quality Splitters and Mixers!

Laceys.tv
TM
42 Brunel Rd Seaford VIC 3198
Tel (03) 9776 9222 web:www.laceys.tv
also Sydney, CoffsHarbour, Ulverstone

Satellite TV Reception

International satellite TV reception in your home is now affordable. Send for your free info pack containing equipment catalog, satellite lists, etc or call for appointment to view. We can display all satellites from 76.5° to 180°.

AV-COMM P/L, 24/9 Powells Rd, Brookvale, NSW 2100.
Tel: 02 9939 4377 or 9939 4378.
Fax: 9939 4376; www.avcomm.com.au

VIDEO - AUDIO - PC

distribution amps - splitters
digital standards converters - tbc's
switchers - cables - adaptors
genlockers - scan converters
bulk vga cable - wallplates

DVS5c & DVS5s
High Performance
Video / S-Video
and Audio Splitters

MD12 Media Distribution Amplifier

QUEST
Quest AV

VGA Splitter
VGS2

HQ VGA
Cables

AWP1
A-V Wallplate

Come to the specialists...
QUESTRONIX®
Quest Electronics® Pty Limited abn 83 003 501 282 t/a Questronix
Products, Specials & Pricelist at www.questronix.com.au
fax (02) 4341 2795 phone (02) 4343 1970
email: questav@questronix.com.au

Little Devil Antennas®

www.ldantennas.com.au
Office: 03 62652148
Mobile: 0409136268
High Performance Antennas

www.aircrafttrackingavionics.com.au
'Kinetic' ADS-B Aircraft Tracking Receiver/Display Kit

Affordable, connects to laptop/desktop PC via USB. Antenna boost accessories now available

Email: mail@aircrafttrackingavionics.com.au
Phone: (03) 9872 3233

CAREER OPPORTUNITY IN WHOLESALE ELECTRONICS

Our company has been a leading designer, manufacturer & wholesaler of electronic security & technology products since 1978. We need passionate & experienced sales and technical staff to join us in providing the best service to our wholesale customers around the world.

In the first instance please send your resume to:
9 Hannabus Place, McGraths Hill NSW 2756
Ph: 02 4577 4708 Fax: 02 4577 4885
Email: manager@rhino.com.au

ELNEC IC PROGRAMMERS

High quality
Realistic prices
Free software updates
Large range of adaptors
Windows 95/98/Me/NT/2k/XP

CLEVERSCOPE
USB OSCILLOSCOPES

2 x 100MSa/s 10bit inputs + trigger
100MHz bandwidth
8 x digital inputs
4M samples/input
Sig-gen + spectrum analyser
Windows 98/Me/NT/2k/XP

IMAGECRAFT C COMPILERS

ANSI C compilers, Windows IDE
AVR, TMS430, ARM7/ARM9
68HC08, 68HC11, 68HC12

GRANTRONICS PTY LTD
www.grantronics.com.au

IDC PCB Connectors

16 Pin RA PCB Header & 16 Pin Socket $21.56*
40 Pin RA Header & 40 Pin PCB Socket $27.89*
Foolproof Polarised PCB Socket
Simplifies Prototyping, Great for Development Boards

*2006 only, includes GST, excluding freight, subject to price rise

Furzy Electronics Software
Design & Development Engineers
www.furzy.com.au
Ph 0407 457 674

Dontronics

www.dontronics.com has 300 selected hardware and software products available from over 40 world wide manufacturers, and authors.

Atmel Programmers And Compilers: AVR-ISP USB In-System Programmer, STK500, Codevision C, Bascom AVR, FED AVIDICY Pro, MikroElektronika Basic and Pascal, Flash File support, and boot loaders.

PICmicro Programmers And Compilers: microEngineering Labs USB programmers, adapters, and Basic Compilers, DIY (Kitsrus) USB programmers, MikroElektronika Basic, Pascal, DSpic Pascal Compilers, CCS C, FED C, Hi-Tech C, MikroElektronika C, disassembler and hex tools.

Other Micros: Tiny Arm, Z80, 8085, etc. hardware and software.

CAN: Lawicell CANUSB, CAN232

FTDI: USB Family of IC 's. FT232RL, FT2452RL, also BL and others.

4DSystems LCD/Graphics: Add VGA monitor, or 1.5" LCD to your micro.

Heaps And Heaps Of USB Products: TTL, RS-232, RS-485, modules, cables, analyzers, CRO's.

Popular Easysync USB To RS-232 Cable: Works when the others fail. Only one recommended by CBUS. Money back guarantee.

www.dontronics-shop.com

humidity, dew point, solar radiation, UV, leaf wetness, etc. Just phone, fax or write for our FREE catalog and price list. Eco Watch: phone (03) 9761 7040; fax (03) 9761 7050; Unit 5, 17 Southfork Drive, Kilsyth, Victoria 3137. ABN 63 006 399 480. **www.davisinstruments.com.au**

SOLID BRASS KNOBS for your amplifier project. 50mm diameter volume knob, weights 3/4lb! (320g). Also 30mm knob, heatsinks and pre-punched chassis. **www.designbuildlisten.com**

RCS RADIO/DESIGN is at 41 Arlewis St, Chester Hill 2162, NSW Australia and has all the published PC boards from SC, EA, ETI, HE, AEM & others. Ph (02) 9738 0330. **sales@rcsradio.com.au, www.rcsradio.com.au**

Do You Eat, Breathe and Sleep TECHNOLOGY?

Opportunities for full-time and part-time positions all over Australia & New Zealand

Jaycar Electronics is a rapidly growing, Australian owned, international retailer with more than 39 stores in Australia and New Zealand. Our aggressive expansion programme has resulted in the need for dedicated individuals to join our team to assist us in achieving our goals.

We pride ourselves on the technical knowledge of our staff. Do you think that the following statements describe you? Please put a tick in the boxes that do:

- ☐ Knowledge of electronics, particularly at component level.
- ☐ Assemble projects or kits yourself for car, computer, audio, etc.
- ☐ Have empathy with others who have the same interest as you.
- ☐ May have worked in some retail already (not obligatory).
- ☐ Have energy, enthusiasm and a personality that enjoys helping people.
- ☐ Appreciates an opportunity for future advancement.
- ☐ Have an eye for detail.

Why not do something you love and get paid for it? Please write or email us with your details, along with your C.V. and any qualifications you may have. We pay a competitive salary, sales commissions and have great benefits like a liberal staff purchase policy.

Send to:
Retail Operations Manager - Jaycar Electronics Pty Ltd
P.O. Box 6424 Silverwater NSW 1811
Email: jobs@jaycar.com.au

Jaycar Electronics is an equal opportunity employer and actively promotes staff from within the organisation.

Jaycar Electronics

RFMA RF Modules Australia

Low Power Wireless Connectivity Specialists

BIM2-433-64-5V
UHF FM Transceiver
In Stock NOW!
Range: 250m
Power: 10mW
Data rate: 64kbps
33mm x 23mm x 4mm

Applications:
Rural
Utilities
Industrial
Commercial
Government
Meter Reading

BIM1-151.300-10
VHF FM Transceiver
In Stock NOW!
Range: 5km+
Power: 100mW
Data rate 10kbps
Also: 151.275 & 151.6MHz

RADIOMETRIX: Low Power, Licence Exempt Radio Modules

RF Modules Australia. P.O. Box 1957 Launceston, TAS., 7250.
Ph: 03-6331-6789. Email: sales@rfmodules.com.au. Web: rfmodules.com.au

DOWNLOAD OUR CATALOG AT
www.iinet.au/~worcom
WORLDWIDE ELECTRONIC COMPONENTS
49a George Street, Kensington WA 6151
Ph: (08) 9367 6330 Fax: (08) 9367 2459
Email: worcom@iinet.net

AKSA
Aspen Amplifiers
Best high end DIY audio kits on the planet!
www.aksaonline.com

PCBs MADE, ONE OR MANY. Any format, hobbyists welcome. Sesame Electronics Phone (02) 9593 1025.
sesame@sesame.com.au
www.sesame.com.au

QUALITY LED TORCHES, 1-watt: Fenix L0P & L1P, CIVICTOR V1 use a single AAA or AA cell. 3-watt: Fenix L1T & L2T with 1 or 2 AA cells. Fenix P1/Nuwai QIII & TM-301X-3 use 1 or 2 CR123A cells. The AIT Nightstar uses no batteries at all! **www.torchworld.com.au/sc/**

SWITCHMODE 5V reg. module kit just $6, or $7 built. 10.5 inch 7-segment display kit from $30. LEDs, nixies, kits, lots of other stuff. **www.ledsales.com.au**

AUDIO RECOVERY

OUTSTANDING AUDIO RECOVERY SERVICES for worn, damaged or broken LP records (vinyl and bakelite) and cassette and reel tapes. Other media by arrangement. If you can play it, we can recover it. Freecall 1300 78 45 76 or visit **www.audiography.com.au**

Printed Circuit Board Manufacture
48-Hour service * High quality * Low prices
1 offs to any quantity
Artwork design if required
Call for obligation free quote...
INSTANT PCBs, POBox 448, Avalon 2107
Ph (02)9974 1189 Fax (02)9974 5491

KIT ASSEMBLY

NEVILLE WALKER KIT ASSEMBLY & REPAIR:
- Australia wide service
- Small production runs
- Specialist "one-off" applications

Phone Neville Walker (07) 3857 2752
Email: **flashdog@optusnet.com.au**

Advertising Index

Aircraft Tracking Avionics 111
Altronics 65,80-83
Amateur Scientist CDs ..... IBC
Aspen Amplifiers 112
Av-Comm 111
Davis Instruments 85,110
Dick Smith Electronics 16-21
Dontronics 111
Elan Audio 7
Furzy Electronics 111
Grantronics 111
Harbuch Electronics 79
Instant PCBs 112
Jaycar IFC,53-60,112
JED Microprocessors 5
Laceys TV 111
Little Devil Antennas 111
Microbric 65
MicroByte Electronics 110
MicroZed Computers 61
Ocean Controls 110
Quest Electronics 111
Radio Parts 3
RCS Radio 111
RhinoCo Technology 111
RF Modules OBC,112
Silicon Chip Binders 25
Silicon Chip Bookshop 108-109
Silicon Chip Car Book 76,88
Silicon Chip Subscriptions 35
Silicon Chip Technology Awards .. 49
Speakerbits 110
Worldwide Elect. Components .. 112

PC Boards

Printed circuit boards for SILICON CHIP projects are made by: RCS Radio Pty Ltd. Phone (02) 9738 0330. Fax (02) 9738 0334.